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# THE SURGICAL CLINICS OF NORTH AMERICA

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Volume 7

Number 6

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## CHOLECYSTITIS AND CHOLELITHIASIS WITH SECONDARY ABSCESS OF THE LIVER

WILLIAM J. MAYO AND VIRGIL S. COUNSELLER

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CHOLECYSTIC disease is usually characterized by pain and tenderness at the right costal margin epigastric distress with bloating and belching coming on soon after eating and if gall stones are present colic may occur at irregular intervals. The pain is epigastric radiating to the back and over the abdomen but in about 5 per cent of cases the pain of colic will be most intense to the left of the median line and occasionally low. Chills and fever nausea and vomiting are usually noted during the acute manifestations. There may be residual abnormal soreness jaundice and choleric stools.

The discovery of gallstones during other operative procedures and at necropsy when according to the history there have been no symptoms has induced many investigators to write on the subject of the innocent or silent gallbladder. Cholecystic disease which has existed for a long time often becomes reactivated and empyema of the gallbladder perforation and abscess of the liver result. Such cases frequently present few symptoms. The two cases presented here illustrate this point.

### CHOLELITHIASIS WITH HEPATIC ABSCESS

**Case I**—A man aged thirty seven came to the Clinic March 9 1925 on account of severe cramps in the abdomen. During the previous twelve to fourteen years he had had many attacks of sudden severe cramp like pain which localized around the umbilicus. The attacks would disappear just as suddenly as they occurred and lasted from a few minutes to an hour. There

was no radiation of the pain, residual abdominal soreness, nausea or vomiting. During the attacks the patient would be doubled up, sweat freely, and feel faint. At first the attacks occurred about every three weeks, but the periods of relief had gradually lengthened until just before his admission, when he had been free from pain for nine months. The pain would continue until relieved by morphin. Two injections of morphin had been required, and on one occasion he had used  $\frac{1}{2}$  grains. There had been no recent loss of weight.

During the routine examinations the patient had what he termed a typical attack of sharp pain at the umbilicus which was relieved by a subcutaneous injection of epinephrin. He was well developed, muscular, and weighed 167 pounds. The systolic blood pressure was 100 and the diastolic 70; the temperature and pulse were normal. Erythrocytes numbered 4,470,000, and leukocytes 7,000, the hemoglobin was 73 per cent. The Wassermann test was negative. Gastric analysis showed total acidity 30 and free hydrochloric acid 10. The roentgenologic examination of the stomach was negative. The urine was normal. The gallbladder and liver-edge were neither tender nor palpable. The skin and sclerotics were clear. Twenty-four hours following the attack there was definite jaundice and the urine was positive for bile. This was the first time during the fourteen years of illness that jaundice had been present. Cholelithiasis was diagnosed and exploration of the gallbladder and ducts was advised.

At operation, March 24, it was found that the gallbladder contained multiple stones which had perforated posteriorly into the liver. There were twelve or more stones in the common and hepatic ducts and in the ampulla of Vater. The gallbladder itself was a mass of scar tissue, and the common and hepatic ducts were greatly thickened. There was an abscess of the liver where the gallbladder had perforated at the fundus, and this abscess contained many stones from the gallbladder. Cholecystectomy and choledochotomy were performed, and the abscess was drained. The appendix, which was chronically inflamed and contained fecal concretions, was removed.

Recovery was uneventful and the patient was dismissed on the eighteenth day.

**Case II.**—A man, aged sixty, entered the Clinic March 1, 1927, on account of partial obstruction of the intestine. Ten days previously he had had an attack of dull aching pain in the left lower quadrant of the abdomen associated with chills, fever, and inability to defecate. At that time colostomy in the descending colon was performed elsewhere as an emergency and a large left pelvic abscess drained. It was thought that the abscess resulted from a perforating malignant lesion of the sigmoid.

On the patient's arrival at the Clinic he was sent directly to the hospital, where the colostomy wound was treated by irrigation and hot packs. Repeated proctoscopic and roentgenologic examinations of the colon did not reveal malignant disease of the sigmoid, but they did show diverticulitis with abscess formation producing obstruction of the sigmoid. He was dismissed from observation in fourteen days and advised that the stoma would be closed some months later. There was no further trouble until June 13,

when a chill occurred and the temperature rose to 102.5°. There was no associated pain or signs of obstruction. He returned to the Clinic June 15. At this time there was an intermittent fever varying from 99° to 102.5°, a chill occurred on the second and fifth days after admission. The leukocytes gradually increased from 7700 to 16,700 on the fourth day. The blood was chemically normal. The urine contained a trace of albumin and pus graded 3. On the fifth day the abdomen became distended and there was persistent hiccough. Examination of the abdomen was otherwise negative. A secondary hepatic or pelvic abscess with obstruction seemed probable. Colostomy was performed in the transverse colon as an emergency for relief of obstruction June 19. The patient died suddenly twenty four hours later.

The conditions noted at necropsy were Chronic ulcerative cholecystitis with cholelithiasis and cholecystoduodenal fistula, abscess of the right lobe of the liver, previous sigmoidostomy for diverticulitis with abscess and recent colostomy for obstruction.

After the necropsy the relatives stated that there had been an attack of jaundice thirty years before.

#### DISCUSSION

These two cases represent a condition that is often encountered in clinical practice and is frequently undiagnosed. The lack of symptoms referable to the gallbladder during the early stages of the disease is responsible for the failure to recognize it. The sudden, sharp, severe pain in Case I radiating to the umbilicus, relieved by morphine, should be sufficient to suggest cholecyctic disease but this patient had been examined by physicians many times each time with a different diagnosis. The symptoms in Case II became manifest just seven days before death, and were not referable to the gallbladder. Necropsy revealed the hepatic abscess which was secondary to chronic cholecystitis and cholelithiasis.

During the seven year period from January 1, 1920 to January 1, 1927 there were twenty seven cases of cholelithiasis with secondary abscess of the liver in which operation was performed at the Clinic. There were four deaths a mortality of 14 per cent. The symptoms elicited and the physical examination revealed definite cholecyctic disease in only five cases (18 per cent). The remaining twenty two cases presented an ancient



history of cholecystic disease sufficient to warrant exploration of the gallbladder

In spite of the tremendous infection of the gallbladder and the abscess of the liver which were present in each case there was very little pain over the gallbladder and no elevation of temperature. In Case II however which was more recent and is not included in the series there was elevation of temperature as well as a chill

Many years ago a great deal was written about innocent gallstone disease which meant that gallstones existed without symptoms and that their presence was not suspected until post mortem examination brought them to light. During this early period the diagnosis was not often made until secondary complications and infections had brought about local signs and symptoms. The mysteries of the disease have however been gradually dispelled by operative interference which has furnished pathologic information of the early stages. With these facts in mind we know that when gallstones are found during the course of any abdominal operation they have produced symptoms at some period during the patient's life and careful elicitation of the history will usually draw suspicion to the gallbladder.

The lack of constitutional disturbances from a gallbladder filled with pus and acutely infective material is due to the absence of lymph nodes and more than a few lymphatic channels in the gallbladder as was pointed out by one of us (W J Mayo) in 1911. It does not have the power to absorb readily and its connective tissue permits of such easy distention that the septic material is not under sufficient tension to force the infection into the circulation. Systemic symptoms occur only when there is cholangitis or obstruction of the common duct as in

## FECAL FISTULA: REPORT OF A CASE

CHARLES H MAYO AND CLAUDE F DIXON

THE patient a man aged fifty, came to the Clinic July 25 1927 because of a fecal fistula in the lower part of the abdomen of fifteen months duration

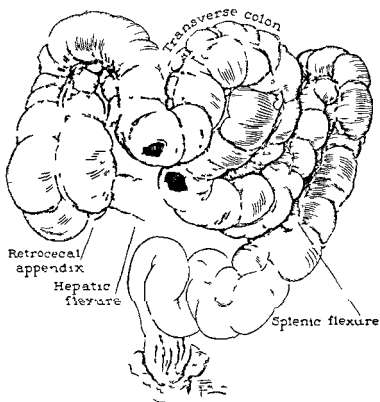


Fig 652—Condition Colon perforated into abdominal wound

He gave a history of having had attacks of pain over the right lower quadrant of the abdomen of ten years' duration. An operation had been performed in 1926, at which time he thought the appendix was removed

The surgeon later informed him that the appendix had not been removed because of adhesions. Nine days after the operation a sinus developed at the site of operation, and drained a great deal of fecal material. Three attempts at closure had been made. At the time the patient registered at the Clinic, almost all of the feces were coming from the fistula.

Operation was performed August 1 (C. H. Mayo) through a median line incision. There were many adhesions. Two openings in the colon were found to open into the abdominal fistula, one in the hepatic flexure and one in the transverse colon. The two openings were brought together, and closed



Fig. 653.—Appendicostomy and anastomosis.

as an anastomosis. The appendix was found to be retrocecal, sealed in its wall, and was brought out through a stab wound as an appendicostomy. A catheter was passed through it and sutured to the stump of the appendix for drainage.

The postoperative course was uneventful. The wound healed by primary intention. There was a great deal of gas and liquid material from the appendicostomy opening. On the tenth day the catheter came out, and on the fourteenth day the necrotic membrane of the appendix was destroyed by cauterization. The patient is doing well at the present time.

Fecal fistulas in the same portion of the intestine are best closed as illustrated in Figs 652 653 If the openings are in different parts of the intestine they should be covered by omentum or rolled over into the close proximity of the mesentery

The appendix acts as a safety valve after appendicostomy, which unquestionably is a safe procedure when it can be done



## REPORTS OF UNUSUAL CASES OBSERVED IN THE CLINIC OF E. STARR JUDD

GUNTHER W. NAGEL AND E. STARR JUDD

NEW conceptions of the physiology of the biliary system have somewhat altered our viewpoint in the diagnosis and treatment of jaundiced patients. This is exemplified in the four cases following

Case I—A man, aged fifty eight had always enjoyed good health until about three weeks before he came to the Clinic, when severe epigastric pain occurred. Shortly afterward the pain shifted to the right upper quadrant, and radiated to the back. Hypodermic injections of morphin were given



Fig 654 —Thick walled, inflamed gallbladder

The pain lasted about three hours, but the soreness continued for a day or two. Three days later a similar attack occurred and three other attacks each less severe, followed. Four days before admission he had had a severe attack, and shortly afterward became jaundiced. In this attack the pain had been more or less continuous.

On examination the patient's jaundice was graded 2 and there was marked tenderness in the upper right quadrant. He was kept in bed in the hospital for several days the jaundice gradually subsiding and the abdominal tenderness becoming less marked. At the end of twelve days his general condition appeared to be satisfactory and operation was performed. The gallbladder was large and thick walled with areas of hemorrhage and gangrene. The omentum was densely adherent to it. It contained 120 or 150 cc of thick foul smelling pus but no stones. It was difficult to explore the common duct because of edema and swelling in the surrounding tissue; however it was felt that it did not contain stones and it therefore was not opened. Cholecystectomy was performed. The fossa of the liver was packed lightly with iodoform gauze and two split tubes and one rubber tube were inserted for drainage. The pathologist reported empyema and acute hemorrhagic cholecystitis on chronic cholecystitis (Fig. 654).

The patient's convalescence was uneventful and the jaundice cleared up completely in a few days. Several months afterward he had an attack of chills and fever without jaundice; its origin could not be determined.

*Comment*—Hemorrhagic and gangrenous gallbladder without stones is rarely seen. The questions to be decided while operating on this patient were whether the gallbladder should be removed or drained and whether the common duct should be explored. Opening the common duct adds to the operative risk, especially in the presence of acute or subacute inflammation, and even after the duct is probed with negative results there is no certainty that a stone has not been overlooked. Stones in the ampulla or common duct cannot always be palpated but if they produce jaundice the duct will be dilated and show evidence of inflammatory change. The jaundice in this case could be readily explained on the basis of inflammation. Operation is not performed immediately when a diagnosis of acute cholecystitis is made, time is allowed for the inflammation to subside. In this way the patient is able to build up resistance to the infection and the gallbladder can be removed with little if any, more risk than in cases of chronic cholecystitis. It is best, if possible, to remove the gallbladder, as the patient's immediate convalescence is much smoother, and the chance for cure much greater. Cholecystitis in most cases is probably only part of the picture, the disease usually affecting more or less the entire biliary system. The point of attack, however, is the gallbladder. Its removal is usually followed by a clearing up of the disease in the

liver and ducts, although this frequently takes from several months to a year or more.

**Case II.**—A man, aged forty-four, three years previously had had an attack of acute colic in the right upper quadrant of the abdomen, radiating to the subscapular region on the right, and accompanied by vomiting. There were no chills, fever, or jaundice. Afterward he noticed spells of mild indigestion until one month before admission, when he had another severe attack of colic, followed by jaundice which persisted until a few days before examination, when another attack occurred and the jaundice increased.

The serum bilirubin was 12.3 mg direct reaction. Calcium chlorid was given intravenously, and the serum bilirubin reduced to 7.1 mg for each 100 c c of blood. The coagulation time fell from thirteen and a half minutes to seven minutes, and the calcium coagulation time from ten to five minutes during the same period.

Operation revealed a large necrotic gallbladder full of stones. There was no bile in the gallbladder. The common duct was small and was located with difficulty. The pancreas was enlarged. Cholecystostomy was performed, and a dressed tube was stitched into the gallbladder, two split tubes were inserted along the side of the gallbladder. *Biliary cirrhosis was marked.*

The patient's convalescence was uneventful. Only a little bile drained through the tube, but after two weeks the tube was removed, and the bile flowed freely for several days and then ceased. The jaundice cleared entirely and the stools became normal in color. The patient has remained well.

*Comment*—Although the gallbladder in this case contained stones, there was no evidence that the common duct was obstructed by calculi. The jaundice might have been due to direct pressure from the neck of the gallbladder, which was large and packed solid with stones, or toxemia or infection may have been a causative factor. In view of the small common duct and the fact that the jaundice could not be explained readily, it seemed advisable to drain the gallbladder rather than remove it. This is frequently done if patients are jaundiced, whether or not the common duct is opened, because the risk is less, and occasionally the gallbladder is useful later for establishing biliary drainage.

**Case III.**—A woman, aged fifty-four, had had about six attacks of soreness in the epigastrium with nausea and vomiting, each lasting about a week. The spells had begun about two years previous to examination, and they continued for one year. There were no chills, fever or jaundice, and no real pain. Seven months before admission the gallbladder was drained. Apparently stones were not found at that time. The patient was well for about five months when she again experienced soreness in the epigastrium, loss of appe-



tite and nausea and shortly afterward she became jaundiced. Only a slight degree of jaundice remained when she entered the Clinic.

On the patient's admission the serum bilirubin was 3.1 mg. for each 100 c.c. of blood. A few days later it was 1.6 mg. Roentgenograms of the gallbladder by the Graham-Cole method showed "invisible" gallbladder cholecystic disease. A roentgenogram of the stomach was negative.

At operation the gallbladder was found to be tense with slight thickening of its walls but no stones. A moderate degree of hepatitis was present. The lumen of the common duct was dilated to about 1.5 cm. in diameter. Careful probing did not reveal stones; the bile was thin and clear. The gallbladder was removed and a catheter stitched into the opening in the common duct. Convalescence was uneventful with the exception of nausea which persisted for several days. Between 500 and 600 c.c. of bile drained daily through the catheter until it came out on the fourteenth day, following which drainage ceased promptly and the stools became normal in color. The patient left for home feeling quite well; the jaundice had disappeared entirely.

*Comment*—Cholecystostomy for chronic cholecystitis with or without stones is frequently followed by recurrence of symptoms. The jaundice in this case suggested involvement of the common duct. The common duct was larger than normal, but probably not larger than it would have been if the gallbladder had been removed or did not function because of disease. In view of the patient's symptoms it seemed best to open the common duct. Whenever the duct is opened it is best to establish drainage. If only brief drainage is necessary, a catheter drain is sufficient since this stays in from ten days to two weeks. If prolonged drainage is necessary because of infection or in certain cases of stricture, a T tube is used. This can be kept in as long as a year if desired. One limb of the T extends upward toward the hepatic ducts and the other toward the duodenum, the stem being brought out through the abdominal wound. It is easily removed and no untoward results follow.

*Case IV*—A man aged thirty-nine had always been well until about six months before admission when he began to experience discomfort in the lower right quadrant. Six weeks previously he had had a severe attack of abdominal pain with nausea and vomiting. Operation was performed elsewhere and an acutely inflamed appendix removed. Examination of the gallbladder at that time was said to be negative except for a few adhesions. Two days after the operation a severe attack of pain occurred in the right upper quadrant of the abdomen radiating through to the back and accompanied by nausea and vomiting. Six attacks occurred during the next four

weeks. A week before his examination at the Clinic a severe attack was followed by jaundice.

The serum bilirubin was 5.0 mg direct van den Bergh reaction. At operation the gallbladder was found to be large and thick walled. There were no stones. The common duct was small but thick walled and the surrounding tissue was edematous. The entire pancreas was definitely inflamed and there was marked hepatitis. The trouble was evidently too acute and diffuse to be benefited by cholecystectomy and cholecystostomy was performed to establish drainage.

The patient did not do well following operation. On the second day 200 c.c. of bile drained through the tube, but after this the quantity lessened each day until the ninth day when 25 c.c. drained; drainage then ceased. On the tenth day the dressed tube was removed. Jaundice became more marked and on the thirteenth day the serum bilirubin was 17.4 mg. Stools were usually clay colored but occasionally there was slight evidence of bile. Vomiting was constant. From 150 to over 1000 c.c. of material was vomited every twenty-four hours. Temperature was normal except for a slight elevation on the second day. The pulse rate averaged 70. Glucose was given intravenously daily.

The patient obviously was growing worse daily. His condition was puzzling. It was thought that a stone in the common duct might have been overlooked. A second operation was performed seventeen days after the first. About the same degree of hepatitis was present as at the first operation. The liver was in better condition than was indicated by the jaundice. The common duct was isolated with some difficulty because of adhesions surrounding it. It was small as before. On opening it a little bile came out. Only the smallest probe would enter the duct but this was readily pushed through the ampulla into the duodenum. The presence of an anomalous condition of the ducts could not be determined or whether the true common duct was opened but certainly the probe passed freely into the duodenum. The hepatic ducts were not identified. There were no stones or strictures. A Robson drain was stitched into the common duct.

Transfusion was given immediately after the operation. The patient remained in a condition of shock and three more transfusions were given during the next twelve hours. There was a moderate amount of oozing from the wound. Thirty cubic centimeters of bile drained through the tube in the first twenty-four hours. The patient failed to rally and died four days after the last operation.

Necropsy verified the conditions found at operation. There was no obstruction in the extrahepatic ducts. Microscopic examination showed marked central necrosis of the lobules of the liver. The small bile ducts were in good condition, but the canaliculi contained bile thrombi.

*Comment*—This case is unusual and difficult to interpret. The severe jaundice and the direct serum bilirubin reaction indicate an obstructive type of jaundice. The obstruction appears to be in the bile canaliculi. The extrahepatic ducts were cer-

tainly not blocked either by stone or stricture. A number of cases termed "obliterative cholangitis" have been noted in which the entire system of intrahepatic and extrahepatic ducts is gradually obliterated by some form of inflammatory disease. This patient's condition must be similar, but it is much more acute and rapidly progressive than usual. Little can be done. Drainage of the extrahepatic ducts is of little benefit when the intrahepatic ducts are also involved. It may be that such drainage helps somewhat by relieving tension and back pressure due to the narrowing of the lumen of the extrahepatic ducts. The administration of glucose intravenously seems to be of some benefit as it tends to stimulate the activity of the liver and increase the flow of bile. In all probability a number of cases previously classified as traumatic stricture of the common duct following cholecystectomy are really cases of obliterative cholangitis. Jaundice in such cases often does not appear until several months or a year or more following cholecystectomy. The disease progresses slowly and can be cured or greatly benefited by prolonged drainage of the common duct with a T tube.

The presence of two distinct lesions requiring surgical treatment is illustrated in the following case.

**Case V**—A woman aged fifty five came for examination with what appeared to be an acute abdominal lesion. Two days previously she had noted gas and a sensation of fulness in the abdomen after the morning meal. She was nauseated and vomited considerably. The next day pain appeared on the right side. It did not radiate downward or to the back. There was no jaundice. The bowels had moved several times since the onset of the illness. With the exception of two or three mild attacks of dyspepsia lasting a week or two and a mild attack of cystitis four years previously the patient's health had been good.

There was tenderness on palpation over the right side of the abdomen. The temperature was slightly elevated. The leukocytes numbered 10 300. The patient was kept in bed on a liquid diet and with an ice cap on the abdomen for several days. There was general improvement, the temperature and soreness decreasing. Further examination of the abdomen disclosed a mass either in the region of the gallbladder or in the kidney, but it was never distinct and seemed to vary from day to day. In view of the history of cystitis and the uncertainty of the diagnosis a urologic examination was made. A pyelogram revealed deformity of the pelvis of the right kidney which was interpreted as either a renal neoplasm or a cyst in the lower pole (Fig 655). Exploration was decided on.

A lumbar incision revealed a simple cyst of the kidney containing clear fluid. The cyst was easily obliterated. The remainder of the kidney seemed normal and there was no evidence of infection. The peritoneum was opened and the gallbladder explored through the same incision. The gallbladder was found to be large and subacutely inflamed. It did not seem advisable



Fig. 655 —Deformity of lower calix of kidney

to remove it through the original incision so the peritoneum was closed, the patient turned on her back, and cholecystectomy performed in the usual manner through a high right rectus incision. The gallbladder was thick-walled, edematous and inflamed and contained stones. Each wound was drained with a split rubber tube. Convalescence was uneventful.

*Comment*—The problem in this case was largely one of diagnosis. There seemed little doubt that a subacute abdominal lesion was present and that it would require surgical intervention. The discovery of the renal lesion complicated matters. The diagnosis lay between simple cyst and malignancy, and the latter possibility made exploration of the kidney imperative. As a rule double operation is not feasible, but in this instance it was clearly indicated.

The unusual condition of hemorrhagic and malignant cysts is shown in the following two cases

**Case VI<sup>1</sup>**—A woman, aged forty nine, gave a history of symptoms for twenty two years beginning with bloating and epigastric distress after eating. She was confined to her bed for two weeks with frequency and burning on urination and the passage of more than a normal amount of urine. Attacks similar to this occurred about every six months and were associated with backache. Eleven years previous to examination she noticed a mass in the left side of the abdomen this had gradually enlarged especially during the last year. For about three weeks there had been almost constant dull dragging pain in the left side and back.

There was a large rounded cystic mass in the left upper quadrant of the abdomen, which moved with respiration and was moderately tender. The urine contained a trace of albumin and an occasional pus cell. The Wassermann reaction on the blood was negative. Cystoscopic examination revealed a normal bladder. The function of both kidneys was approximately normal and equal. The pyelogram of the left kidney showed the pelvis and upper major calyx to be incompletely filled. There was a faint outline of a soft mass in the left renal area. A diagnosis was made of either renal cyst or extrarenal tumor.

At operation a large round cyst was found arising in the lower pole of the left kidney. It was approximately 10 cm. in diameter, thick walled and bluish black. The diagnosis lay between true hemorrhagic cyst and hemorrhagic cyst secondary to a neoplasm. Inasmuch as the function of the kidney was normal and the cyst involved only one pole of the kidney, it was thought advisable to resect the cyst and preserve the kidney unless evidence of malignancy could be demonstrated in the cyst. The cyst was removed and the raw surfaces of the kidney and pelvis sutured with catgut. The wound was drained. Convalescence was uneventful.

*Comment*—Hemorrhagic cysts of the kidney are rare. The symptoms, as in this case, are dull dragging pain in the renal area, usually of several years' duration and associated with indefinite gastro-intestinal symptoms and the presence of a tumor. Urinary symptoms are usually absent or only mild. Hematuria is rarely present. The etiology of these cysts has not been definitely established. It was thought that they might originate from an aneurysm, in which clotting has advanced to such an extent that the lumen of the vessel has been occluded and the aneurysm has been transformed into a cystic cavity. The possibility of this mode of origin is strengthened by the microscopic appearance of the wall of the cyst in this particular case. It has three layers. Externally, the renal capsule with scattered areas of atrophic renal parenchyma under it, the middle layer of connec-

<sup>1</sup> Notes on the clinical data in this case were made by Dr. H. E. Simon.

tive tissue containing a few muscle fibers and the third or innermost layer, consisting of elastic tissue with numerous small vascular channels and covered in places by remnants of endothelium. The cyst contained blood clots roughly arranged in layers, especially in the peripheral zones, while in the central portion of the cavity there was bloody fluid. The uninvolved portion of the kidney, as in this case, is frequently normal and its function good, so that resection of the cyst rather than nephrectomy is the operation of choice.

**Case VII**<sup>1</sup>—A woman, aged fifty-nine, came to the Clinic because of severe backache of several years' duration, much more severe during the last year. A dragging sensation was relieved by a tightly laced corset. There were no urinary symptoms.

On examination a smooth movable mass was found in the right upper quadrant of the abdomen. Repeated examinations of the urine were negative. The hemoglobin and blood counts were normal. The blood urea was 24 mg. for each 100 c.c. of blood and the renal function by the phenolsulphonephthalein test was 55 per cent. Roentgenograms revealed an enlarged right renal shadow, and a pyelogram showed complete obliteration of the calices of this kidney. Solitary cyst of the right kidney was diagnosed.

Exploration revealed a large carcinomatous cyst about 9 cm. in diameter situated in the central portion of the right kidney. There was no evidence of extension of the disease into the pedicle or the perirenal fat. Nephrectomy was performed. The pathologist reported adenocarcinoma of a papillary type with areas of hemorrhagic and cystic degeneration. The postoperative course was uneventful.

*Comment*—The symptoms in cases of renal tumor are very inconstant. Pain, blood in the urine, and a palpable mass when present are helpful in making the diagnosis. Diagnostic urologic procedures should be carried out whenever disease of the upper urinary tract is suspected. Renal tumors are readily amenable to surgical treatment, and if operated on early the prognosis is good.

Anatomic variations and congenital anomalies are more frequent than is generally supposed. Often they do not cause symptoms and are only brought to light when some pathologic lesion is superimposed upon them. An illustrative case follows.

<sup>1</sup> Notes on the clinical data in this case were made by Dr. A. P. Synhorst.

**Case VIII**<sup>1</sup>—A man aged thirty one came to the Clinic complaining of repeated attacks of hematuria the first occurring seven years previously. About a year before his admission a violent attack of pain occurred in the right hypochondrium radiating to the lumbar region. There was no fever, abdominal tenderness or vomiting. Appendectomy was performed elsewhere and on the second day the occurrence of severe hematuria necessitated transfusion. For the last year the hematuria occurred once or twice a month usually associated with dull aching in the right hypochondrium and right lumbar region. Each attack lasted from one to seven days.

Examination of the urine showed macroscopic and microscopic blood. The blood urea was 34 mg. for each 100 c.c. and the phenolsulphonephthalein



Fig. 656—Two ureters with normal pelvis above and dilated pelvis and hydro-ureter below.

test showed renal function of 30 per cent. Urologic examination showed complete duplication of the pelvis and ureter on the right side. The lower half contained a large infected hydronephrotic sac (Fig. 656). The function of the lower half was markedly decreased but the upper pelvis appeared normal and function was normal.

At operation a large double kidney with two ureters was found. There was a huge hydronephrotic sac of the lower half with a hydro-ureter extending down about 5 cm. and then changing abruptly into a normal sized ureter. The upper pole of the kidney with the ureter and pelvis appeared normal. Nephrectomy was performed. Convalescence was without incident.

*Comment*—Because of the danger of interference with circulation to the upper pole it was deemed advisable to remove all

<sup>1</sup> Notes on the clinical data in this case were made by Dr. A. P. Synhorst.

of the double kidney. The cause of hydronephrosis is not clearly understood. No anomalous vessel capable of producing pressure on the ureter was noticed in this case. Congenital points of narrowing in the ureter or developmental anomalies may play a part in the production of hydronephrosis. Plastic operations on the renal pelvis are unsuccessful as a rule, especially in the presence of infection. Nephrectomy is the operation of choice.

The following case is one of marked hypertrophy of the pyloric sphincter muscle.

**Case IX**—A man, aged forty seven, gave a history of having had stomach trouble for ten years. He was a generous user of alcohol. He said that he could never fully digest a meal, and the resulting abdominal discomfort was not relieved until he forced himself to vomit copiously.

The Wassermann reaction on the blood was negative. Gastric analysis showed total acidity 38, free hydrochloric acid 24, and total volume 70 c c. The roentgenologist reported the presence of a duodenal ulcer.

At operation a thick, firm pyloric muscle was found. The stomach was moderately dilated. There was no evidence of ulceration. The anterior half of the pyloric sphincter was excised and gastroduodenostomy performed. Careful inspection of the gastric and duodenal mucosa did not reveal evidence of ulceration. Because of the presence of marked hepatitis, cholecystectomy was also performed. Convalescence was uneventful. The patient has remained well for a year.

*Comment.*—In two or three cases similar to this, a markedly hypertrophied sphincter muscle seemed to be the chief cause of



Fig. 657.—Normal and hypertrophied pyloric sphincter muscles.

symptoms. Normally in adults the sphincter is from 5 to 10 mm. wide and from 5 to 9 mm. thick. In this case the corresponding measurements were 2 and 1.6 cm. (Fig. 657). Microscopic ex-



amination showed moderate round cell infiltration in the submucosa and muscle layers. Excision of the anterior part of the pyloric sphincter and gastroduodenostomy have been successful in cases of duodenal ulcer and duodenitis. Spasm of the pyloric sphincter seems to play a part in cases of duodenitis and ulcer of the duodenum. Operation permanently relieves the condition and removes the lesion as well. This case was complicated by changes in the biliary tract. However, even if removal of the gallbladder helped reflexly to relax the pyloric spasm it could hardly have reduced the tremendous muscular hypertrophy.

Malignant lesions of the small intestine are not common, they comprise only about 3 per cent of all malignant lesions of the intestinal tract. A recent review of records in the Clinic showed fifteen cases of carcinoma of the duodenum, fifteen of the jejunum, and nine of the ileum. To these the following five cases are added:

**Case X**—A woman, aged fifty-six, had had indigestion for the last four or five years, manifested by gas and epigastric distress coming on two or three hours after eating and relieved by belching or by taking soda. During the last year progressive symptoms of obstruction had appeared, and recently the vomitus has contained a little bright red blood. Slight pain in the epigastrium, radiating along both costal margins to the back, had occurred at times two to three hours after eating. It was relieved by soda but made worse by food. The patient had lost considerable weight and strength.

Gastric analysis showed total acidity 60, free hydrochloric acid 40, and total volume 500 c.c. Roentgenologic examination disclosed an obstructive lesion at the outlet with rather marked gastric retention. Posterior gastroenterostomy was performed. At this time it was not possible to decide

— There  
There  
gastro

enterostomy and three weeks later the stomach was partially resected. The growth proved to be an ulcerating carcinoma, 2.4 cm. in diameter, situated at the pylorus and extending about an equal distance on the gastric and duodenal sides. The pathologist found carcinoma in both the gastric and duodenal epithelium. The patient convalesced uneventfully and left for home feeling considerably improved.

*Comment*—Carcinoma of the duodenum is either primary or secondary, this case was an example of the latter. Secondary carcinoma usually results from extension of cancer of the head

of the pancreas or of the ampulla of Vater or from cancer of the pylorus. The pylorus in most cases seems to form a barrier preventing extension of carcinoma of the stomach into the duodenum. However, careful examination of carcinoma of the pylorus occasionally shows extension of from 1 to 2 cm. onto the duodenal side. It is not advisable to resect much beyond the pylorus for fear of injuring the common duct. Usually resection just distal to the pylorus is sufficient.

**Case XL.**—A man aged forty-five came to the Clinic complaining of stomach trouble of about four years' duration with occasional periods of slight distress in the epigastrium appearing an hour or so after eating and

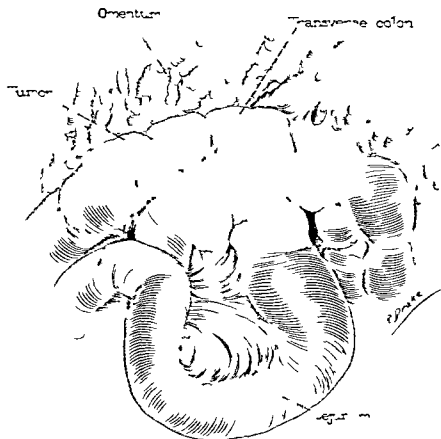


Fig. 658.—Tumor in gastro-enterostomy stomach.

usually relieved by food or soda. At times sour eructations occurred and food had to be chosen carefully. Two years previous to examination he began to lose weight and the epigastric distress became more marked and

lasted for longer periods although at no time was it severe. His physician diagnosed duodenal ulcer. He went to bed for ten days on a Sippy regimen and gained slightly in weight but his general health did not improve and gastro enterostomy was performed sixteen months prior to his admission to the Clinic. He did not do well following the operation. Small amounts of food caused his stomach to feel full and he vomited with increasing frequency.

The patient appeared to be underweight and undernourished. A movable mass about 6 cm. in diameter was palpated just below the umbilicus. The hemoglobin was 70 per cent. Examination of the urine and the Wassermann reaction on the blood were negative. Gastric analysis showed total acidity 22 free hydrochloric acid 14 and total quantity 360 c.c. Roentgenograms revealed a malfunctioning gastro enterostomy but no other apparent lesions in the stomach or duodenum. At operation a malignant tumor was found in the gastro enteric stoma (Fig. 658). The tumor appeared to involve chiefly the jejunum but it also penetrated the colon and extended slightly into the stomach through the gastro-enteric opening. The growth was freely movable and no abdominal metastasis could be made out. About 15 cm. of jejunum almost the entire transverse colon and about 7.5 cm. of stomach together with the growth were resected; an end-to-end anastomosis was made between each of the resected organs. The pathologist reported lymphosarcoma involving chiefly the jejunum without lymphatic involvement. The patient made an uneventful recovery.

*Comment*—This is the first case observed in the Clinic of a malignant lesion developing in the region of a gastro enteric stoma. In this case the tumor appeared to have formed on the jejunal side and extended to the colon and stomach. It does not seem likely that gastro enterostomy had anything to do with its development. At the time of the operation it was not possible to find a lesion at the pylorus or in the first portion of the duodenum. Lymphosarcoma occasionally occurs in the jejunum. The case was complicated from both a diagnostic and surgical standpoint by the presence of the gastro enteric opening. In view of the close association between gastric ulcer and carcinoma it may at first thought appear remarkable that carcinoma does not develop more frequently at the site of a secondary ulcer in a gastro enteric stoma. In most cases secondary ulcer probably occurs on the jejunal side and this may explain the absence of malignant degeneration in these cases.

Malignancy of the small intestine usually occurs in the form of ring carcinoma. Such carcinoma early produces symptoms of intestinal obstruction but nevertheless, is rarely diagnosed.

clinically. As a rule it does not metastasize early to distant organs, but often the nearby lymph nodes in the mesentery are so extensively involved that resection is impossible. Three such cases are reported:

Case XII.—A man aged sixty-nine, had been in fairly good health, with the exception of one severe attack of epigastric pain five years before his admission to the Clinic which required a hypodermic for relief. The trouble of which he complained on admission had begun about three months previously when he was suddenly seized with severe epigastric pain and vomiting. An attack of influenza followed this. There was soreness in the abdomen and diarrhea. A week or so before he had begun to vomit everything he ate. The vomitus frequently contained particles of food eaten the day before. There was a constant feeling of weight in the epigastrium. He had been constipated for years. He had lost 30 pounds in the last three months.



Fig 659 —Carcinoma of ileum

Peristalsis was visible. The hemoglobin was 80 per cent. The Wassermann reaction on the blood was negative. Gastric analysis showed total acidity 8, with no free hydrochloric acid, and a volume of 215 c c. Roent-

dilated. There were two lesions in the bowel, one about 15 cm above the ileocecal valve producing marked obstruction, and the second about one meter above the first. Both were widely resected and end to-end anastomoses made. Both lesions proved to be adenocarcinoma, graded 2 (Fig 659).

One was 1.5 cm. in diameter and the other 1 cm. Convalescence was uneventful and the patient left the hospital feeling quite well, but a few days later he began to vomit again. The abdomen was not distended, the bowels moved freely with catharsis. The blood urea was normal. Daily gastric lavage was given and fluids were administered by proctoclysis and intravenously. The patient gradually became weaker however and died. At necropsy the intestinal anastomoses were found to be satisfactory, but the bowel had become adherent and there was slight mechanical obstruction. There was no evidence of metastasis or local recurrence of the growth. In the patient's weakened condition and in the absence of any other apparent cause, it would seem that the slight mechanical obstruction was sufficient to cause death.

**Case XIII**—A man, aged forty three, was brought to the Clinic by his home physician, who had performed resection for carcinoma of the sigmoid and a colostomy one and a half years previously. The patient had always been fairly well, but had worked hard, was nervous and suffered from heart burn, belching and occasional attacks of nausea and vomiting. The operation had been performed because of subacute obstruction. Following the operation the patient improved rapidly until about two weeks before he came to the Clinic when he began to lose strength and weight. Abdominal distention and belching with occasional cramps and some nausea and vomiting were still present. He was brought to the Clinic with the idea of having the colostomy opening closed, but in view of recent symptoms it was thought best to postpone the operation.

After ten days the patient's symptoms having grown worse abdominal exploration was decided on with closing of the colostomy opening if everything appeared favorable. At this time the hemoglobin was 52 per cent and the erythrocytes numbered 3,800,000. The color index was 0.6. The Wassermann reaction on the blood was negative. A ring carcinoma of the small intestine was found to be causing moderate obstruction. There was no evidence of metastasis and the growth was resected. The exact site of the tumor was not determined but it appeared to be in the lower part of the jejunum. The patient recovered uneventfully and was dismissed from the hospital feeling well. A few weeks later he returned for closure of the colostomy opening. The large bowel had been closed below the point where the growth had been removed and there was a short blind end of the loop distal to the colostomy opening. This was resected and the proximal portion joined to the distal end by means of an end to end anastomosis. Convalescence was uneventful.

**Case XIV**—A man, aged forty three, had come to the Clinic six and a half years before and gastro-enterostomy had been performed for perforating duodenal ulcer with obstruction. The symptoms were relieved. About two years later pneumonia developed and was followed by empyema. Surgical drainage was instituted and from this time on his health had not been good. He came to the Clinic again about a year before his last admission complaining of itching of the skin, jerking of the limbs and other nervous symptoms.

Examination at this time revealed marked anemia. The hemoglobin was 38 per cent. Erythrocytes numbered 3 560 000 and the color index was 0.5+. Gastric analysis showed total acidity 14, no free hydrochloric acid, and total volume 45 c.c. Roentgenograms at this time showed the duodenal cap to be deformed and the gastroenteric stoma free. Two and a half months before admission he commenced taking osteopathic treatments for anemia and shortly afterward began to vomit. The vomiting persisted and was of the retention type. He grew progressively weaker and lost 24 pounds in weight.

The patient was considerably emaciated and anemic. The hemoglobin was 42 per cent, the erythrocytes numbered 3 420 000. The systolic blood pressure was 90, the diastolic 60. Gastric analysis showed total acidity 28, no free hydrochloric acid, and total volume 1 000 c.c. Roentgenograms of the stomach showed obstruction in the distal loop of the gastroenterostomy.

At operation the gastroenteric opening was apparently normal. About 25 or 30 cm. from the opening on the distal loop was what appeared to be a primary malignant growth of the jejunum with extensive involvement in the adjacent mesenteric nodes making it impossible to remove the growth. The jejunum did not appear to be greatly obstructed, but in view of the patient's symptoms an enteroanastomosis was made, short-circuiting the growth. The patient convalesced uneventfully and was given a course of radium treatment before he went home.

Benign lesions of the jejunum are rare, the most common being stomal or gastrojejunal ulcer. Ulcer of the jejunum without previous gastroenterostomy occasionally occurs. The following case is illustrative.

Case XV.—A man, aged forty-one, complained of having had intermittent attacks of stomach trouble for four years. At the onset he had gnawing distress in the epigastrium four hours after eating, which was relieved by food. Two years later he had gastric hemorrhage. He was relieved for a period of fifteen months on a Sippy diet when there was a recurrence and he became worse steadily. The abdomen was bloated and he frequently vomited small amounts of fluid and mucus. Three months prior to admission a gastric ulcer had been excised and appendectomy performed. He grew progressively worse, however, and lost weight and strength. He had had gonorrhea twice and when thirty-four years of age had had a syphilitic genital lesion.

The patient was considerably emaciated, pupils were small and irregular and reacted to accommodation but not to light. There was visible peristalsis in the upper abdomen. The hemoglobin was 78 per cent, the erythrocytes numbered 4 880 000 and the leukocytes 7 500. Examination of the urine was negative. The Wassermann reaction on the blood was negative. Gastric analysis showed total acidity 32, free hydrochloric acid 20, and total volume 300 c.c. Roentgenograms showed obstruction of the jejunum. Jejunal obstruction and parenchymatous syphilis were diagnosed.

At operation two constrictions of the jejunum were found, one 6 and the other 10 cm below the duodenojejunal flexure. Above the constriction the bowel was thin, dilated, and flaccid. The bowel near the constrictions was acutely inflamed, thick and firm, and the serosa reddened and covered with serofibrinous exudate. Ten centimeters of the intestine, including the

two weeks feeling better than he had in years.

On opening the specimen a perforating ulcer was found at the site of the upper constriction and two smaller ulcers at the lower constriction (Fig. 660). The largest ulcer measured 1.5 cm. in its greatest diameter and was 5 mm. in depth, with slightly irregular steeply shelving edges. The smallest ulcer measured 6 by 3 mm. and had overhanging edges. The largest ulcer had almost perforated the wall of the bowel. There was considerable induration and thickening of the bowel immediately adjacent to the ulcer.



Fig. 660 —Stricture of the jejunum showing ulceration

Microscopic examination showed the mucosa and submucosa ending abruptly at the margins of the ulcers. The floors were inflammatory connective tissue covered with serofibrinous exudate, containing many lymphocytes, plasma cells, and some eosinophils and leukocytes. The tissue surrounding the ulcer was infiltrated with newly formed connective tissue rich in lymphocytes and plasma cells and with occasional groups of leukocytes. The walls of the arterioles were thickened and there was marked perivascular lymphocytic infiltration. Similar changes were found in the veins. There were no tubercles or giant cells. The pathologic diagnosis was inflammatory lesion of the jejunum with ulceration and stricture, possibly syphilitic.

*Comment*—Primary ulcers of the jejunum are most frequently caused by syphilis, although it is not always possible to prove this and some of the lesions may be tuberculous or simple non-

specific inflammatory lesions. Intestinal syphilis is frequently found with congenital syphilis but is a rare manifestation of the acquired form of the disease. It may occur during the secondary stages of the disease, coincident with the exanthem. This form is manifested by a catarrhal enteritis; the symptoms corresponding with those of the nonspecific form of this disease: pain, diarrhea, tenesmus, and bloody stools.

The most common syphilitic lesions of the bowel are those occurring as tertiary manifestations of the disease. These consist of gummatous infiltration of the mucosa and submucosa with ulceration and extension to the muscle and serous layers. Secondary inflammation, and cicatrization and constriction of the bowel are common. Perforation and peritonitis may occur.

The symptoms are variable and may simulate peptic ulcer, ulcerative colitis or intestinal stenosis. Pain is a common symptom and may be related to meals. Diarrhea with blood and pus in the stools is common. If constriction has occurred there is pain, abdominal distention and vomiting. A presumptive diagnosis of intestinal syphilis is made from these symptoms if there are other manifestations of the disease. A positive Wassermann reaction is not essential to the diagnosis. Tuberculous lesions may simulate the condition grossly, but can be differentiated microscopically by the characteristic tubercles and giant cells. Nonspecific ulcers show the characteristic tissue reaction found in simple inflammatory ulcers in other regions of the intestinal tract.

In the presence of ulcer and stricture, whatever the cause, the treatment is surgical. The lesion is frequently limited to a small area and is amenable to surgical treatment. General anti-syphilitic measures are also instituted when indicated.

Tumor of the carotid body is illustrated in the following case:

**Case XVI<sup>1</sup>**—A woman aged forty-nine came to the Clinic with a diagnosis of stone in the right ureter. The diagnosis was confirmed and the stone removed without incident. A small lump had appeared in the left side of the neck about three years previously. It had not caused discomfort but seemed to vary in size from time to time. A small nodule 3 or 4

<sup>1</sup> Notes on the clinical data in this case were made by Dr. P. G. Flothow.



cm. in diameter could be felt in the upper left cervical region. A diagnosis of probable branchial cyst was made.

At operation a tumor was found to lie in the carotid notch. A good sized vessel, apparently an anomalous artery, passed over the tumor. Compression of the artery did not cause the patient inconvenience so it was ligated and the tumor removed. Convalescence was uneventful. There was no evidence of any cerebral disturbance and the patient was allowed to get up on the tenth day.

*Comment*—The tumor was firmly attached to the wall of the artery which was removed with it. It was rather soft and red dish gray on cut section. Microscopically it was made up largely of chromaffin cells and areolar tissue. Such tumors are rare. Pathologically they seem to be benign but they tend to recur



Fig. 661—Tumor of carotid body

locally (Fig. 661). They do not metastasize. Their close association with the carotid vessels sometimes necessitates ligation of these vessels during their removal. The vascular disturbance which occasionally follows may cause a debilitating brain lesion. The carotid body is classified among the chromaffin glands of internal secretion analogous to the suprarenals and closely related histogenetically to the sympathetic nervous system. The function of its internal secretion has not been definitely estab-

lished, but it seems to act chiefly on the vascular system. Small doses of its extract have a depressor effect antagonistic to that of epinephrin.

Cardiospasm is rarely treated surgically. Case XVII is illustrative of such treatment.

**Case XVII**—A man aged sixty first began to notice a choking sensation at the age of twenty two when he ate and some difficulty in swallowing liquids as well as solids. The condition grew slowly worse until he came to the Clinic for the first time two years before the present visit. Roentgenologic examination at this time revealed cardiospasm and a tremendously dilated esophagus (Fig. 662). Several attempts were made to dilate the cardia, but the hydrostatic dilator could not be introduced. A silk thread



Fig. 662—Cardiospasm with greatly dilated esophagus

was swallowed and passed through the narrow point, but even then the dilator could not enter the cardia. The patient was instructed to empty his esophagus by postural drainage. He had a good appetite, ate moderately well, and was able to carry on his business. A certain amount of food undoubtedly passed through the opening. For the last few months the spasm had become more marked, very little food entered the stomach and he began to lose weight and strength.

Since dilators could not be passed from above an abdominal operation was necessary. The patient swallowed a silk thread to furnish a guide. The stomach was opened and with the aid of the thread the cardiac orifice was easily located from below. At first it would not admit even the little finger

With slow pressure however it was gradually dilated until it readily admitted two fingers. The stomach was then closed.

*Comment*—In most cases cardiac spasm can be cured by dilatation through the esophagus. A hydrostatic dilator is used and is guided into position by means of a silk thread which has been previously swallowed. Operations have been devised for anastomosing the dilated esophagus to the stomach but such procedures are unnecessary. Often a single dilatation is sufficient to effect a cure. Sometimes the procedure has to be repeated more often. If further dilatation should become necessary, in this case the hydrostatic dilator can undoubtedly be used.

## PROBLEMS IN THE SURGICAL TREATMENT OF PEPTIC ULCER

DONALD C BALFOUR

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**Case I Gastrojejunocolic fistula** (history abstracted by Daniel P. Greenlee) —A man, aged sixty, came to the Clinic in May, 1927, complaining of diarrhea, which had begun two years before. The essential feature of the history relative to the presenting complaint was that gastro enterostomy had been performed (elsewhere) in 1916 for chronic duodenal ulcer. Preceding gastro enterostomy the patient had suffered from definite symptoms of peptic ulcer for eight or nine months. Convalescence had been normal and there had been no evidence of recurrence of ulcer symptoms since that time. The diarrhea was painless and there were no cramps. There was neither blood nor mucus in the stools, which varied in number from four to six during the day and from three to five at night. Usually undigested food, eaten from five to six hours earlier, was found in the stools. On account of loss of strength the patient had been unable to work since December, 1926.

The patient was markedly emaciated and weighed only 98 pounds, having lost 45 pounds in six months. There were a few carious teeth, otherwise the general examination was negative. The test meal showed achlorhydria and the total gastric contents measured 350 c c. Roentgenogram of the stomach revealed a gastrojejunal ulcer. The roentgenogram of the colon was unsatisfactory. Two examinations of the stool were negative for ova and parasites.

The patient was kept in the hospital for several days before operation, while measures were taken to restore the body fluids and improve the general condition. At exploration a jejunocolic fistula was found. The colon was first dissected free from the inflammatory mass, the opening in it closed, and then the old gastro enteric anastomosis was undone, and a new gastro enterostomy of the Roux type performed, the end of the proximal loop of the jejunum being implanted in the side of the distal loop of jejunum. The postoperative course was absolutely uneventful.

*Comment* —The subject of gastrojejunal ulcer and its complications, particularly colic fistula, has many points of interest. This case of gastrojejunocolic fistula is presented because it illustrates some of the unusual features of colic fistula in a striking way. In the first place, following gastro enterostomy, the symp-

toms of ulcer had been completely relieved for a period of eleven years. At no time had there been any suggestion of recurrence of pain or of any distress related to meals. The development of gastrojejunal fistula without preceding symptoms of ulceration is unusual but a number of such cases have been seen in the Clinic. Eusterman knows of five patients with so called silent gastrojejunal fistula that have been seen in the Clinic.

It is important in these cases to advise surgical treatment as soon as the condition is recognized. Early operation is less difficult and safer and insures satisfactory end results. In this case the jejunum was separated from the colon, the fistula (about 1 cm. in diameter) closed, the gastroenteric anastomosis undone and a section of the jejunum resected. The jejunum was united to the stomach after the method of Roux, that is, the end of the distal loop of jejunum was implanted in the gastric opening after the latter had been sufficiently closed and the end of the proximal loop was implanted in the side of the distal loop of jejunum.

The patient left the hospital eleven days after operation. The diarrhea had ceased completely and there was even then marked improvement in the patient's general appearance. During the first few days of convalescence retention of bile in the stomach was avoided by aspiration with a stomach tube at least twice a day.

A recent communication from the patient tells that he gained 36 pounds in weight in two months following the operation.

**Case II** Perforating gastric ulcer with hour glass deformity, and duodenal ulcer (history abstracted by Robert D. V. Jones, Jr.)—A married woman, aged twenty-nine, came to the Clinic in July, 1927. She had complained of a gnawing distress in the stomach for one year. The distress usually occurred from two to three hours after meals and was relieved at first by the ingestion of food or soda. Later there was less regularity as to the time of the distress and the attacks seemed to bear no relations to the taking of food. A heavy meal, however, caused a sensation of fullness and nausea which were relieved by vomiting. Roentgenologic studies made elsewhere had shown an hour glass contraction of the stomach. For a year the patient had adhered to a restricted diet of milk and cream but had obtained no relief.

The general examination was negative except that the patient was high-strung and nervous and appeared to be much older than her years. The tonsils were chronically infected. The total gastric acidity was 46 and the

free hydrochloric acid 30, roentgenologic examination of the stomach and duodenum showed a gastric ulcer high on the lesser curvature of the stomach producing hour-glass deformity.

At exploration gastric ulcer was found 4 or 5 cm above the angle of the stomach with an hour-glass contraction narrowing the stomach at this point to a diameter of about 2 or 3 cm. There was also a subacute duodenal ulcer about 1 cm distal to the pylorus. In order to remove both lesions partial gastrectomy and partial duodenectomy were performed. An end-to-end anastomosis between the upper segment of the stomach and the duodenum was made without undue tension. Convalescence was uneventful.

*Comment.*—Of the major complications associated with gastric ulcer, namely hemorrhage, perforation, obstruction, malignant degeneration, and hour-glass contraction, the last is one of the most interesting from a surgical standpoint. About twenty-

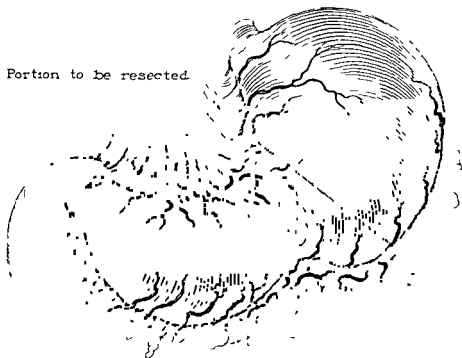


Fig 663.—Resection of the stomach for an hour-glass contraction

five cases of hour-glass contraction of the stomach were seen in the Clinic last year, so that the relative frequency of occurrence would be about once in sixteen cases of gastric ulcer. In some instances the hour-glass is hardly worthy of the name because of the early stage in which the complication is seen.

A number of operations have been devised for the relief of hour glass contraction. The most satisfactory one is naturally the simplest that will give complete and permanent cure, and this is probably anastomosis made in front of the hour glass

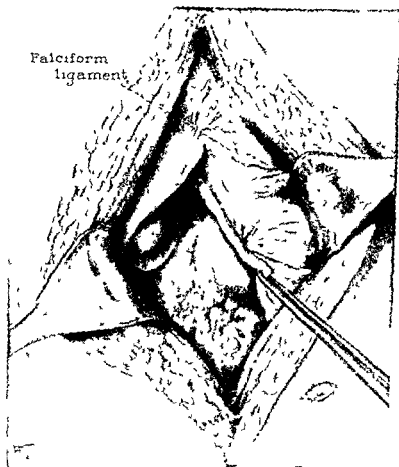


Fig 664 —Suturing the pyloric end of the stomach to round ligament of the liver

contraction. Although some surgeons report that they have never met with carcinomatous ulcer associated with an hour-glass contraction and therefore rely entirely on gastro enterostomy, we are inclined in the Clinic to excise the contracted

portion of the stomach and bring the two ends of stomach together. This operation has usually been followed by excellent results.

In this case the finding of a duodenal ulcer, together with the gastric ulcer and hour-glass contraction, necessitated considerable modification of the usual methods of treatment. A good result would probably have followed multiple operations such as excision of the gastric ulcer and gastro-enterostomy on each segment of the stomach, gastrogastrostomy and gastro-enterostomy on the lower segment with excision of the ulcer, or segmental resection, including the gastric ulcer, followed by gastro-enterostomy to compensate for the pyloric obstruction. Since one procedure would suffice it seemed reasonable to choose that. Therefore, partial duodenectomy and partial gastrectomy were performed, beginning the resection below the contraction of the duodenum and continuing the mobilization of the stomach into the upper segment (Fig 663). It was then found that the upper segment and the stump of the duodenum could be so mobilized that an end-to-end anastomosis between the upper segment and duodenum could be accomplished. This was done, convalescence has been satisfactory, and one can anticipate a good result. The practice of fixing the stomach at a point about 2.5 cm. below the suture line to the round ligament of the liver is of especial importance in such extensive resection of the Billroth I type (Fig 664).

**Case III Multiple jejunal ulcers following partial gastrectomy (history abstracted by Robert D. V. Jones, Jr.).**—A man, aged forty eight had had a very active business career. It was his habit to work under high nervous tension and to smoke heavily, when feeling well he was quite irregular in his habits. In 1917, when he first came to the Clinic the history and symptoms were typical of peptic ulcer of between ten and twelve years duration. Posterior gastro-enterostomy had been performed elsewhere. The operation was followed almost immediately by recurrence of symptoms. The site of the pain, however, was somewhat lower and to the left of its original site. The distress was easily controlled by diet and the use of alkalis, but, after six years it was complicated by hemorrhage.

The diagnosis of gastrojejunal ulcer was confirmed at exploration. The anastomosis was undone, the gastrojejunal ulcer excised, the openings in the stomach and jejunum closed, and gastroduodenostomy performed. The old



ulcer was found on the posterior wall of the duodenum, but no attempt was made to remove it. Following this operation, the patient remained in good health for three years. At that time there was a second recurrence of symptoms which was later complicated by intermittent attacks of retention. In the summer of 1925 the patient returned to the Clinic and pyloric obstruction with hyperacidity was diagnosed. The stomach was markedly enlarged. Exploration was advised, but the patient was unable to remain for operation.

Finally, in March, 1927, he returned for operation. The pylorus was thickened and adherent to the anterior abdominal wall. The wall of the



Fig. 665 — Three ulcers in vicinity of end to side anastomosis

stomach was thickened, but no definite lesion was found. Because of the tendency to ulcer formation in this case, partial gastrectomy was considered advisable. The transverse colon was bound down by adhesions, therefore, it was necessary, in restoring gastro intestinal continuity, to perform an end to side gastrojejunostomy in front of the colon. An entero-anastomosis was made between the proximal and distal loops of the jejunum. The immediate convalescence was uneventful. About six weeks later the patient suffered an attack of sudden severe pain in the left costovertebral angle. This was followed by others of the same character which were progressively more severe and more frequent. The attacks appeared to have no relation to

the former distress. A renal lesion was suspected; however, repeated cystoscopic examinations were negative. In July the patient was advised to remain in the hospital for observation, and it was noted that the time of the attacks was the same as that of the former ulcer pain. Although the roentgenogram of the stomach was negative, recurrent ulcer was diagnosed. The patient was placed on a milk-and-cream diet with alkalis, and the pain was relieved. A subsequent roentgenogram revealed perforating jejunal ulcer.

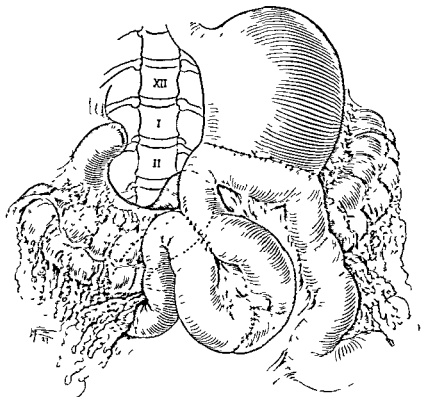


Fig 666 —New end-to-side anastomosis after resection of jejunal and gastro-jejunal ulcers and closure of jejunum.

At exploration three lesions were found (Fig 665): a large ulcer in the line of anastomosis; a second on the anterior wall of the jejunum perforating onto the diaphragm, and a third on the posterior wall of the jejunum. The stomach was separated from the diaphragm, the anastomosis was undone, the ulcers were excised, and a new end-to-side anastomosis was carried out between the stomach and the jejunum, just distal to the entero-anastomosis (Fig. 666). Clamps were not used for the anastomosis.

*Comment.*—Every case of recurring ulcer presents many debatable points. In this case it was unusually difficult to determine the cause of the recurrences. It is of interest that the patient exhibited all the complications of ulcer except malign-

nant degeneration, hemorrhage after the first recurrence, obstruction after the second and acute perforation with the third. As Lusterman has pointed out, the important fact from the standpoint of diagnosis is that any late recurrent symptoms after gastro enterostomy that are identical with the preoperative symptoms irrespective of laboratory data, should be attributed to a gastrojejunal lesion until proved otherwise. Although the symptoms were not those of ulcer as far as the site and radiation of pain were concerned the periodicity of the pain and its relation to meals were such as to convince the clinicians that ulceration had recurred even though the primary roentgenologic examinations were negative.

It is unusual to find multiple jejunal ulcers occurring so soon after partial gastrectomy. The ulcers were unquestionably acute and for some reason did not heal, it is debatable whether or not the small amount of acid in the gastric contents was responsible for the failure to heal. This case illustrates the fact that no operation for peptic ulcer necessarily protects the patient from recurrence of ulceration. This is as true of partial gastrectomy as it is of gastro enterostomy. We have seen recurrences at the Clinic after every type of resection the Billroth I and II and their modifications and segmental resection of the stomach.

As possible causative factors of recurrence in this case we have first, the type of patient who is prone to recurrence of ulceration second the failure of resection to eliminate free hydrochloric acid and third trauma. There is the possibility, of course that the diversion of too much of the alkaline duodenal contents through the entero anastomosis and away from the stomach has been partly responsible for the ulceration.

**Case IV Partial duodenectomy for subacute duodenal ulcer (history abstracted by Robert D V Jones, Jr)**—A physician aged forty four came to the Clinic in June 1927 complaining of epigastric distress. At that time he gave a typical history of peptic ulcer of eight or nine years duration. His mother had died of cancer of the rectum. At the onset of the illness the patient had suffered with mild attacks of burning epigastric distress which seemed to occur only when he was worried or overworked. At first the attacks came regularly two or three times a year lasting only for a few days. For the previous five years however the attacks had become progressively

more frequent and more severe until finally he had been compelled to give up his work. During the last year there had been daily discomfort with acute exacerbation of pain every two or three weeks. During these attacks the pain had come with regularity between 11 00 a m and noon, between 3 00 and 4 00 p m, and between 11 00 p m and midnight. The ingestion of food or soda had always brought relief. Occasionally there had been associated nausea and vomiting, and on one occasion four years previously there had been blood in the vomitus. The general examination was essentially negative. The total gastric acidity was 44 and the free hydrochloric acid 22, the roentgenologic examination of the stomach was positive for duodenal ulcer. Urinalysis and the Wassermann test were negative. The hemoglobin was 74 per cent.

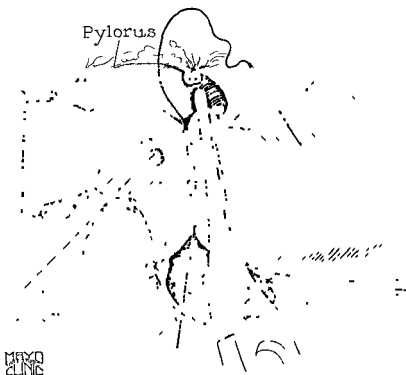


Fig 667 —Partial duodenectomy for subacute duodenal ulcer.

On exploration a subacute duodenal ulcer was found on the posterior wall about 4 cm below the pylorus. It was firmly attached to the pancreas. Because of the history of hemorrhage it was thought best to excise the lesion if possible. The duodenum was mobilized to a point below the lesion and partial duodenectomy and pylorotomy were performed (Fig 667). The stump of the duodenum was closed and a posterior Polya anastomosis was made.

From the standpoint of gastric symptoms, convalescence was uneventful. On the tenth day following operation, however, the wound began to drain clear yellow fluid. The following day there was considerable congestion

of the skin around the edges of the wound which suggested pancreatic fistula. In order to protect the skin an aspirator was devised which drew the secretion immediately from the fistula. Abdominal dressings were discontinued and the wound protected by means of a cradle. After several days the irritation of the skin disappeared and the fistula closed. At no time during the convalescence was there any chemical disturbance of the blood.

*Comment*—I believe it cannot be disputed that it is advantageous to remove large posterior crater-ulcers of the duodenum. Usually, however, the difficulty and risk of removal more than counterbalance the uncertainty of good results by an indirect operation alone. In this case, although the lesion had perforated into the pancreas and was at least 2.5 cm. from the pylorus, its removal was apparently desirable and justifiable.



Fig. 668.—Method of aspirating a pancreatic fistula.

The best exposure in such cases is provided by division of the stomach above the pylorus and dissection of the remainder of the pyloric end of the stomach, the pylorus and the duodenum down to a point below the ulcer. The intent in this case was to restore gastro-intestinal continuity by a direct end-to-end union of the stomach and duodenum. However, when the duodenum below the ulcer was mobilized, it was found that such a narrow margin of the posterior wall remained and it was in such a friable con-

dition that it was a question whether satisfactory healing would follow a direct end to end union. It was, therefore, considered safer to close the duodenal stump. Even this was done with some difficulty and necessitated considerable suturing in the head of the pancreas. The stump was thoroughly protected with omentum following the closure, a posterior end to side gastrojejunostomy was performed the end of the stomach being brought down through the mesocolon.

During convalescence fluid strongly suggestive of pancreatic secretion began to drain from the abdominal wound on the tenth day and continued for several days. The suction apparatus (Fig 668) under such circumstances again proved its efficiency in preventing irritation of the skin. The entire absence of chemical disturbance of the blood during the discharge indicates, judging from Walters' experimental studies in animals that only a very small quantity of pancreatic secretion was lost.

The patient recovered satisfactorily and in a recent letter states that he is completely well.



## DERANGEMENT OF THE INTERNAL SEMILUNAR CARTILAGE OF THE KNEE-JOINT

MELVIN S HENDERSON

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### CATCHING IN THE KNEE DUE TO HYPERMOBILE CARTILAGE

**Case I.**—A woman, aged twenty four, a nurse, was examined January 13, 1927. Nine years before she had fallen while skating and injured her left knee. Persistent swelling followed. Her physician thought he could feel a loose cartilage. For some time something had seemed to pop out on the inner side of the left knee joint when she made a misstep or twisted her knee. She was always able to push the lump back and thus obtain relief, but the condition was so persistent and gave her such a feeling of insecurity that she felt that something should be done, and exploration was advised. The left knee joint was opened through an anterior internal incision. Fracture could not be demonstrated in the internal semilunar cartilage, but it was hypermobile, accordingly the anterior three fifths of the cartilage was removed. Physiotherapy was carried out for several weeks in the form of baking and massage for the purpose of developing the quadriceps. The patient has had no further trouble and is relieved of all symptoms.

*Comment*—This case is an example of the removal of the internal semilunar cartilage when there was no pathologic change demonstrable in the body of the cartilage, the cartilage being removed on the subjective data only. The cartilage seemed to be hypermobile, but this is a factor which varies in different individuals. It is probable that in cases of this type the internal capsule is lax, permitting the semilunar cartilage to catch between the internal condyle of the femur and the inner tuberosity of the tibia, and doubling it up sufficiently to make a prominence on the inner side of the knee anteriorly, but not to fracture or tear the cartilage in its substance. Although by manipulation and pressure the protuberance can be made to slip back into place, its frequent occurrence and the uncertainty and annoyance are irritating to the patient. However, the subjective symptoms of derangement must be definite to warrant the removal of the meniscus.



# LOOP OR BUCKET HANDLE TYPE OF FRACTURE OF THE INTERNAL SEMILUNAR CARTILAGE

**Case II**—A laborer aged thirty was examined at the Clinic January 17 1927. Five years previously he had injured the left knee while playing baseball and was confined to bed with a swollen knee which he could not extend. There were no symptoms for several months but the patient then noticed that on putting a strain on the internal lateral ligament by eversion of the foot and abduction of the leg there was a snap in the joint and the knee would catch so that he could not straighten it. This flexion would remain for a week or two and then extension would gradually return.

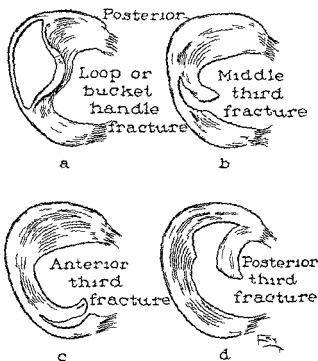


Fig. 669.—Common types of fracture of internal semilunar cartilage

He was unable to straighten the knee completely and there was tenderness to pressure along the inner side anteriorly. Fractured internal semilunar cartilage was diagnosed. The knee was opened by an anterior internal incision and the internal semilunar cartilage found to be fractured. It was torn loose along the middle three fifths but it was still attached anteriorly and posteriorly causing the cartilage to loop across into the intercondylar notch. This is a typical bucket handle type of fracture described by Rutherford Morrison (Fig. 669a). The anterior attachment was freed and the loop

pulled forward and cut off posteriorly It was immediately possible to extend the knee fully

*Comment*—In this fracture, which is a rather common type, a loop of cartilage slipped into the intercondylar notch The prominent symptom was inability completely to extend the knee Sometimes this can only be detected by asking the patient to stand erect with the toes and heels together and then try to straighten the knees It will be seen that the affected knee lacks a few degrees of complete extension Typical locking does not often occur but unless the cartilage slips back from the intercondylar position complete extension cannot be obtained

### FRACTURE IN THE MIDDLE THIRD OF THE INTERNAL SEMILUNAR CARTILAGE

**Case III**—A man aged forty two was examined at the Clinic June 22 1927 In 1918 while playing baseball his foot slipped from under him as he was getting up after sliding to third base and a great strain was put on the inner side of the right knee There was a sensation of something tearing and sharp pain developed on the medial aspect of the right knee On attempting to walk he found that he could not straighten the leg and was forced to walk on the ball of the foot He managed to get home with the aid of crutches and stayed in bed for three or four days His physician diagnosed torn ligaments and treated the leg by hot fomentations bandages and liniments Marked effusion followed which lasted for about ten days and the patient was unable to work (firing an engine) for three weeks Four weeks later while he was playing baseball the tearing again occurred Effusion followed, but it was not so marked as before He was unable to work for ten days but the knee gradually improved and could be fully extended He had no further trouble until a year before examination when his leg gave under him as he was making a turn in walking downstairs He grasped the banisters to save himself from falling Slight effusion followed He could not extend the leg completely and was away from work for several days Eight days before examination he twisted his leg when stepping from his engine and it gave way under him The same symptoms followed with the exception that there was very little swelling

Examination of the knee disclosed all movement to be full painless and free in all directions and there was no apparent wasting of the quadriceps There was no crepitation and extension was complete There was no hypermobility There was slight tenderness on the inner side at the femoral attachment of the internal lateral ligament A diagnosis of fractured internal semilunar cartilage was made and the joint was opened by an anterior internal incision At first glance the cartilage appeared normal, but further back in the joint the cartilage was found to be fractured in the posterior portion of the middle third There was an ear shaped pedicled flap which flopped

back and forth in the joint (Fig 669b) The cartilage was removed almost in its entirety by dissecting carefully along the internal capsule and swinging the cartilage over into the intercondylar notch pulling it forward and cutting off the posterior attachment with curved scissors

*Comment*—In the typical derangement of the knee due to injury to the internal semilunar cartilage the early attacks are more severe, the disability is greater and more effusion is present As time goes on, the fractured part of the cartilage becomes worn and smoothed out so that it will more readily slip back into place after being caught Unless a thorough search had been made, the small, pedicled flap in this case would have been overlooked The six year period of freedom from symptoms is interesting, and can only be accounted for by the healing of the fracture in the cartilage It is unlikely that for six years the pedicled flap found at operation could have been present without giving symptoms It is more probable that a new tear was produced in the cartilage at the time the recent symptoms developed

#### FRACTURE IN THE ANTERIOR THIRD OF THE INTERNAL SEMILUNAR CARTILAGE

**Case IV**—A farmer aged twenty one was examined at the Clinic July 18 1927 While playing football two years previously he was heavily tackled and his knee was wrenched and dislocated The knee was locked in flexion and straightened with a loud snap as his comrades pulled vigorously on it Since then the knee locked with increasing frequency and effusion always followed Several times while he worked or played the knee locked by merely a slight twist of the leg

Examination was negative except for slight crepitus in the left knee joint and slight laxness Extension was complete The knee was explored through an anterior internal incision and the cartilage was found to be fractured in the anterior extremity (Fig 669c) A pedunculated bulbous bit was hanging free in the joint and could readily be caught between the bones Since the remainder of the cartilage seemed to be normal only the anterior half was removed

*Comment*—With the clear cut history in this case there could be little doubt of the presence of fractured cartilage Since the fracture was confined to the anterior extremity of the cartilage and was plainly visible, it was not necessary to traumatize the

joint further by removal of the entire cartilage. Convalescence was uneventful and the patient was dismissed, walking without a cane or crutch, ten days after the operation.

### FRACTURE IN THE POSTERIOR THIRD OF THE INTERNAL SEMILUNAR CARTILAGE

**Case V**—A student aged twenty was examined at the Clinic July 22 1927. Nine months previously his leg had been forcibly abducted while he was playing football and he fell. Severe pain was experienced on the inner side of the knee and there was soreness for about a week. The knee was injured repeatedly after this and at times he noted that full extension was lacking.

The patient was well developed and an athlete. There was slight crepitation in the right knee on motion and pain over the internal lateral ligament. When he was asked to stand erect and extend both legs completely it could be seen that extension of the right knee was not quite complete. Exploration was carried out through an anterior internal incision. There was some effusion and the fluid was deep amber. On examining the joint a small piece of fibrous tag could be seen lying in the intercondylar notch which at first thought appeared to be a ruptured crucial ligament but the stability of the knee was not impaired. The history of this particular type of injury with eversion of the foot and abduction of the leg and the lack of complete extension was sufficient to warrant the removal of the meniscus. Accordingly the anterior end was freed but on dissecting along the internal lateral ligament and pulling on the cartilage it separated and the anterior half was in the forceps. Since a satisfactory hold could not be secured on the posterior portion a posterior internal lateral incision was made just anterior to the hamstrings. On opening the joint cavity and grasping the posterior portion of the cartilage and pulling on it a long pedunculated flap was pulled out from the intercondylar notch (Fig 669d). The tip of this flap was the fibrous tag that could be seen in the intercondylar notch in the anterior incision. Both incisions were closed and a posterior splint applied. Convalescence was normal. The patient volunteered the information that the knee felt right and comfortable. The knee could be extended readily.

*Comment*—This is an example of a tear or fracture in the posterior portion of the cartilage. The nature of the tear was such that the anterior portion of the cartilage came out in an attempt to remove the entire cartilage, leaving the posterior portion. It was necessary to make another incision and remove the fractured segment. The internal posterolateral incision is useful in just this type of case.

## TECHNIC OF REMOVAL OF THE INTERNAL SEMILUNAR CARTILAGE

The technic employed in these cases is briefly as follows

The leg is prepared, the patient anesthetized and a tourniquet applied. The leg is hung over the foot of the table at a right angle. A straight incision, about two fingers' breadth to the inner side of the patellar tendon is made about 5 cm long close to the internal condylar line, extending down across the joint

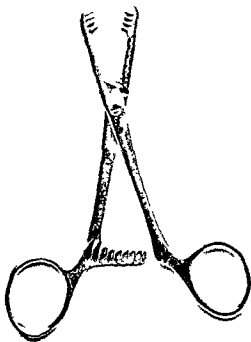


Fig 670 —Martins forceps for grasping the internal sem lunar cartilage

line to the head of the tibia. The cartilage is loosened at the anterior extremity by dissection with a knife and the anterior end is grasped with strong forceps with corrugated lips (Martins' forceps) (Fig 670). The dissection is continued posteriorly close to the internal ligament. When the cartilage is freed far enough posteriorly the tibia is manipulated on the femur so as to sepa

rate the internal condyle as much as possible from the tibia, and the loosened cartilage is swung over into the intercondylar notch. The posterior part of the cartilage can then be cut with a pair of sharp curved scissors or a thin bladed knife after it has been pushed back along the internal capsule. This removes the cartilage in practically its entirety. The wound is closed in layers, the knee extended, and the skin closed. A posterior splint or plaster of Paris cast is applied and worn for a week. The stitches are removed in about ten days. If convenient, physiotherapy is given to encourage contraction of the quadriceps. However, the earliest possible return to function is the best recipe for a quick recovery. Since by this method of incision and removal of the cartilage no ligaments or muscles of any importance are molested, there is no good reason why early use of the knee should not be encouraged.



## CASES FROM THE CLINIC OF HENRY W. MEYERDING

HENRY W. MEYERDING

### UNUNITED FRACTURE OF THE HIP, WITH FIBULA USED AS A BONE GRAFT

Case I—A girl aged twenty one fell while riding horseback fracturing the neck of the left femur. She was treated with a Thomas extension splint for fifteen and a half weeks and was then permitted to be up and about, bearing some weight on the extremity. At the end of three months she began to walk with a cane and by the seventh month she returned to work for two weeks. Roentgenograms were taken which showed malposition, and she



Fig 671—Case I Ununited fracture of left hip eight months following injury

noticed that the leg was apparently becoming shorter and that she had some pain when she was up and about. She was told that union was not strong and was referred by her attending physician for operation.

The patient was on crutches and did not bear weight on the left leg. There was slight local tenderness and limitation of motion of the left hip. There was 2.5 cm shortening and eversion deformity with slight atrophy of the leg. Roentgenograms showed ununited fracture of the neck of the



left femur, with upward displacement of the trochanter. Open reduction and pegging with the fibula was advised.

The hip-joint was exposed through an anterior incision, nonunion being demonstrated in the neck of the femur, and the fractured ends were freshened with a chisel and curet. A small incision over the trochanter was made, a hole carefully drilled through the trochanter, neck and head of the femur, and a bone graft, consisting of the entire thickness of the fibula, was driven through the trochanter, neck and into the head, firmly fixing it in position. Small particles of cancellous bone were then forced firmly between the fractured ends as if to cement the ends together, and an osteoperiosteal graft was turned around the fracture site. A double spica cast was applied to the toes

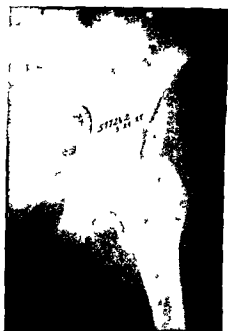


Fig. 672.—Case I. Result of bone graft and use of bone chips in a nonunion of the hip, four and a half months after operation.

on the left, and to the knee on the right, with the left hip in extension, internal rotation and abduction. The patient withstood the operation well, and there was no elevation of temperature or pulse following it. The roentgenograms showed excellent position. The patient was dismissed in the fourth month with a spica cast to the knee, which she was advised to wear for another three months, at the end of which time she was to have a roentgenogram taken. Six months after operation she writes: "My cast was removed, and I am walking fine." (Figs. 671, 672.)

I prefer the Whitman treatment of recent fractures of the hip as Whitman has found that abduction, internal rotation, and extension hold the fractured surfaces in firm apposition, and a properly applied plaster cast affords secure external fixation, at the same time allowing the patient to be moved and cared for easily and practically painlessly. The length of time fixation is maintained depends on the rapidity of healing, but the usual time is six months. When the patient is first up and about weight bearing should be increased gradually and repeated roentgenograms should be taken to determine the position, although perfect position may be obtained at the time of reduction or favorable impaction be found at the time of fracture. Too early and too great strain causes slipping of the fragments and nonunion. Incomplete reduction, insufficient fixation, and too early weight bearing are frequent causes of failure to obtain satisfactory results.

On consultation, the surgeon must decide what operation, if any, is best suited to the need of the patient with nonunion of the hip. Frequently the age and general condition of the patient contraindicate long, difficult surgical procedures and the operation must be planned to take as little time and as little of the patient's strength as possible. In the case reported, the head and neck of the femur remained in fair condition eight months after the fracture, and the case was then ideal for bone grafting. The fibula was used because of its strength, size, the ease of its removal, and the little time necessary to fit it into the hole made by a medium sized Murphy reamer. Cancellous bone to fill the crevices about the line of fracture appears to assist union especially if the bone is enclosed by a circular layer of osteoperiosteal graft. The immediate application of a well padded double spica cast is most useful in obtaining added fixation, making the patient comfortable and promoting healing of the wound.

In older patients with nonunion who are in good physical condition excellent results may be obtained by this operation, and time may be saved by having the assistant remove the fibula while the surgeon prepares the hip for reception of the graft.

# OSTEOMYELITIS OF THE FEMUR, PREVIOUSLY DIAGNOSED SARCOMA

Case II.—The relative of a boy, aged ten, wrote to the Clinic asking what could be done for cancer of the bone. He said that a definite diagnosis had not been given, and that amputation had been advised. Pathologic fracture had occurred. It was advised that the patient be brought to the Clinic for examination. A history was elicited of a severe injury to the right thigh a year previous to examination, but the child was not incapacitated. Three months later swelling was noted in the right thigh, and pain and fever developed. He was in bed for several weeks. Seven months after the injury he fell fracturing the femur and was treated with extension and a Thomas splint. He had not walked on the leg for nine months.



Fig. 673 —Case II Osteomyelitis of the femur, with sequestrum

There was swelling of the thigh with slight local heat, but no tenderness. The right thigh measured 35.5 cm. in circumference, and the left thigh 34 cm. Movement hyperextends; no atrophy.

negative. The roentgenologist's diagnosis was tumor of the right femur with old fracture and considerable absorption and proliferation; roentgenograms of the lungs were negative. The surgeon's diagnosis was osteomyelitis and he advised exploration under tourniquet.

The operation was performed about a year following the injury. An incision was made along the inner side of the thigh, over the prominent portion of the bony mass and this led to an area of pus. A sequestrum, 10 cm. long and from 2.3 to 1.9 cm. wide, was removed. There had evidently been a large hematoma behind the femur and this cavity was carefully curetted.

and two Carrell tubes inserted for drainage and irrigation with Dakin's solution. The pathologist reported inflammatory tissue and sequestrum. The patient was dismissed from observation on the seventeenth day (Fig. 673).

Osteomyelitis is frequently diagnosed and treated as sarcoma especially if the infectious organism is due to staphylococci of low virulence, the cultures in this case showed the presence of such an organism. No doubt the infection had been present for months as is shown by the huge sequestrum and by the history of pain, swelling, and finally of fracture. At the time of examination there was no fever, leukocytosis, or local tenderness but the hardness of the thigh with local heat was strongly suggestive of malignancy. Elevation of the periosteum showed new bone formation at the upper border of the involved area which simulated the condition seen in sarcoma. The sequestrum was at such an angle that it could be distinguished from the femur easily, especially as it lay in an area of decreased density and was formed from the cortex where it had broken down. The periosteal swelling and induration resulted from this undrained infection. If roentgenograms are properly taken at right angles and interpreted by an experienced roentgenologist or surgeon, most bone tumors can be correctly diagnosed. However there remains a group in which the history and laboratory data give valuable aid and whose nature cannot be determined without exploration and pathologic examination. No doubt all of us have seen those rarer cases in which the true nature of the tumor was not discovered until metastasis developed or necropsy was performed. In children, infection of the bone is much more common than malignancy.

#### GIANT-CELL TUMOR OF THE RIGHT TIBIA, TREATED BY OPERATION AND BONE GRAFT

Case III—A farmer's wife aged twenty came for examination complaining of pain in the upper third of the right tibia of nine months' duration. She was practically incapacitated. The pain was first noticed when she was climbing stairs or when she suddenly put strain on the joint. For the last few months the pain had become more severe as the patient was kept awake at night. Gradually increasing swelling was noticed. She was anemic and her head ached. She was slightly underweight but her general health was good.

Examination of the right leg showed a mass in the upper end of the tibia. There was slight tenderness and slight local heat but there was no limitation of motion. Urinalysis was negative. Hemoglobin was 68 per cent and the Wassermann test on the blood was negative. The roentgenologist reported giant cell tumor of the upper end of the right tibia. Roentgenograms of the chest were negative.

The relatives and the patient were anxious to have the extremity saved and came to the Clinic in the hope that something might be done to avoid amputation, which had been considered. As the roentgenograms showed

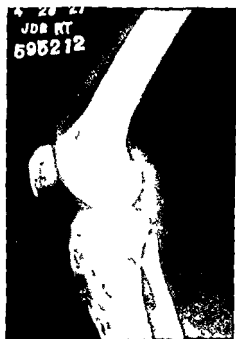


Fig. 674—Case III. Giant cell tumor destroying the upper fourth of the tibia.

considerable destruction of the upper end of the tibia it was thought advisable to attempt to save the bone. An incision was made along the surface of the tibia by bone saw. The tumor was removed, and the cortex was exposed. A fluid was found in the cavity, which could be removed. After thorough cleansing of the cavity, the incision was extended down to the lower end of the tibia and a large bone graft removed from the flat internal surface of the tibia. This was divided into sections and placed in the cavity so as to support the articular surface of the tibia. The periosteum was then

tightly sutured, and a plaster cast applied. The pathologist's diagnosis was giant cell tumor. Convalescence was uneventful. The patient was dismissed wearing a cast from the toes to the hip (Figs 674-675).

In the past, tumors of this type frequently were amputated following exploration, curettage, cautery, and so forth, with subsequent infection and osteomyelitis or septic arthritis. Packing and irrigation with antiseptics controlled the terrific hemor-

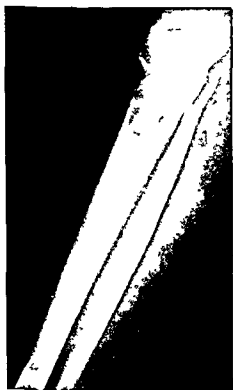


Fig 675—Case III. Giant cell tumor removed by curettage, and bone grafts inserted. Note buckling of tibia.

rhage, and "dakimization," of wounds controlled the infection, but left open wounds which had to be kept clean and sometimes required secondary closure.

Roentgen-ray and radium treatment over long periods was beneficial and further study may prove this to be the method of choice in selected cases, or prove that this may be used as an aid to surgery.

My object in this case was to remove the tumor, which was

proved to be benign by pathologic examination, to prevent infection, save a useful extremity, and to get the patient back to her home in the shortest time possible with a minimal amount of expense. The patient was up and about within a few weeks without discomfort. On weight-bearing the soft shell of bone buckled a little, but roentgenograms showed good position and firm fusion of the grafted supports after union by primary intention in six weeks. Three months after operation the cast was removed and the patient began to walk.

#### ELEVEN-YEAR CURE OF SARCOMA, FOLLOWING AMPUTATION

Case IV.—A woman, aged thirty, came to the Clinic complaining of a recurring tumor in the region of the left ankle. She had sustained an injury to the left ankle fifteen years previously in a fall while horseback riding. She was able to walk immediately after the accident, but there was a good deal of swelling and ecchymosis on the inner side of the ankle. Six months after the accident, the patient walked in a perfectly normal manner, but the discoloration remained over the inner aspect of the ankle for three or four years. The enlargement became painful and she walked on the ball of the foot because of pain and inability to get the heel to the ground. Four years before examination at the Clinic the tumor which was about 7 cm. in diameter, was excised. Since then the patient had had eight operations, the last one being eight and a half months before. Each operation was followed by healing, then recurrence. A diagnosis had been made of osteosarcoma carcinoma and necrosis of bone.

Examination showed a large ulcerated mass 3 by 4 cm. on the inner side of the left ankle, apparently a nodular tumor superficial to bone. The patient's general condition was good. In the last six years she gained 80 pounds, her present weight being 286 pounds. The urinalysis was negative. Roentgenograms of the ankle joint were reported negative.

A specimen removed for pathologic examination showed sarcoma. Four days later, a second large section of the tumor was removed for further study and again sarcoma was diagnosed (Fig 676). No metastasis could be demonstrated. The patient consented to amputation when doubt of malignancy was cleared up, and three days after the second biopsy the leg was amputated in the middle third of the tibia. The patient was dismissed from the hospital on the seventeenth day with the stump practically healed, and referred to her home physician. Three months later the patient's husband wrote that his wife was feeling well, but there was a small hard lump on the end of the bone, and in front. In October, 1912, six months later, the patient replied to a circular letter that her weight was about the same, and there was no recurrence, the wound was still open. She had had no roentgen ray treatment since she left the Clinic. In August, 1913 the patient again wrote us that she never felt better, that the wound

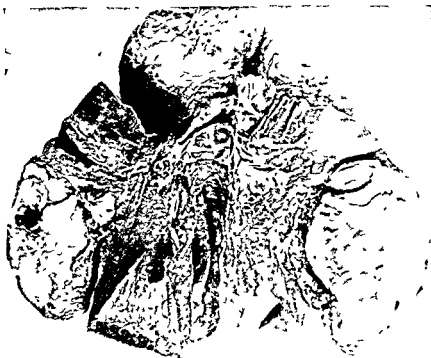


Fig 676.—Case IV Pulmonary metastasis, from sarcoma of the foot



Fig. 677.—Case IV Metastatic sarcoma of lungs, eleven years after amputation.



was still open and her physician advised keeping it open. In response to an inquiry March 29 1915 she said that her weight was the same that there was no recurrence of the tumor and she was enjoying the best of health.

November 1922 eleven years after the operation we received a letter from the patient's attending physician saying: "Eight months ago she contracted influenza having been practically well and working as a domestic in a tuberculosis sanatorium. Following the influenza she developed chronic respiratory symptoms with fever and entered our tuberculosis department a few months ago. She was discharged from there those in charge of her deciding that she did not have tuberculosis as they could never find the bacilli in her abundant sputum. Her illness cough sputum and fever persisted and she entered my ward (general medicine) about two weeks ago running an irregular fever between 100° and 103° a mild hyperleukocytosis and a profound secondary anemia. Withal she was not emaciated (Fig 677).

November 15 a letter from one of the physicians at the University of California stated that at necropsy of this patient metastatic myxosarcoma of both lungs was found.

*Comment*—This is an unusual case of sarcoma. Trauma at the age of fifteen to the external malleolus. Persistent pain swelling and discoloration, with marked increase in weight. Repeated operations (ten in all) between the ages of twenty six and thirty. Sarcoma diagnosed clinically and pathologically. Slow healing and amputation of stump. Apparent excellent health until eight months before death eleven years after amputation fifteen years after first excision of the tumor and twenty six years after original injury.

### MULTIPLE MYELOMA

*Case V*—The patient a machinist aged fifty two complained of arthritis of two years duration which he believed had resulted from a fall from a plow. The pain occurred principally in the back and chest at times it was in the muscles of the arms and legs. The patient had noticed gradually increasing deformity of the spine and he walked in a stooped position. The condition was aggravated by changes in the weather. There had been no night sweats and no fever but occasional dizziness and frequency occurred.

The patient was poorly nourished and had lost 47 pounds in weight in the last two years. The blood pressure and pulse were normal and the temperature was 99°. He stood in a stooped position with the spine rigid except in the cervical region and he complained of tenderness on jarring. There was 3 cm expansion of the chest. Urinalysis showed 1150 cc in twelve hours the specific gravity was 1.010 and the reaction acid. Albumin was graded 4 an occasional red blood cell and an occasional pus cell were

found Hemoglobin was 48 per cent, leukocytes numbered 5,900 and erythrocytes 3,360 000 The Wassermann test on the blood was negative The roentgenologist reported marked atrophy of the spine with hypertrophic arthritis of the dorsal and lumbar spine The clinician's diagnosis was spondylitis deformans, with marked atrophy of the bones Roentgenograms of the teeth were negative Examination revealed prostatitis, graded 2 culture showed green producing streptococci, and a few staphylococci Treatment of the prostate was advised

The anemia and the large amount of albumin in the urine suggested the advisability of a test for Bence-Jones protein, and further roentgenograms The second urinalysis showed the presence of Bence Jones protein in large quantities, and from the roentgenograms of the skull, forearms and legs, myeloma was diagnosed (Fig 678)



Fig 678—Case V. Multiple myelomas showing marked involvement of skull with punched-out areas of decreased density

Roentgenologists should bear this rare disease in mind wherever the thorax appears to be involved by multiple lesions, especially when albumin appears in the urine Although Bence-Jones protein is rarely present in cases of leukemia, nephritis, and carcinomatosis, it is found in 80 per cent of the cases of multiple myeloma The clinical history is often of little value early in these cases, although vague rheumatic and neuritic pains, with or without fever, and later weakness, loss of weight

and anemia, are common, first suggesting rheumatism and then malignancy

Differentiation of metastasis and carcinoma is usually not difficult. The history of a primary lesion with areas of involvement near the middle of the bone and near the entrance to the blood vessels with severe continuous pain and rapid growth demonstrates its malignant character, and death soon follows. The absence of Bence Jones protein is also an aid to diagnosis. Metastasis from the breast may occur in areas similar to those involved by myeloma, but palpation or a history of previous operation will clear up this diagnosis. Metastasis from the prostate is usually to the pelvic bones, lumbar spine and sacrum, the entire bone may appear sclerosed. The thorax, ribs, and sternum, which are studded with growths in cases of myeloma, are rarely involved by prostatic metastasis.

Hypernephroma is differentiated by the history, the clinical and laboratory data, and especially by hematoma. Multiple endothelioma may strongly simulate multiple myeloma, and in the absence of the Bence Jones protein it can hardly be differentiated roentgenologically. Sarcoma is rarely distributed widely and occurs, most commonly in middle life, near the ends of the long bones. In the bone producing types, the roentgenologic examination reveals the true type in 90 per cent of the cases if properly prepared plates are examined by an expert. If there is absorption of bone, the site of the lesion near the ends of the long bones, a single lesion rather than multiple ones, severe local pain, and rapid growth are usually sufficient to differentiate this type of lesion. Metastasis to the lungs should always be looked for, and roentgenograms of the chest give the first clue to this.

Osteomalacia usually occurs in women. It does not involve the skull and it is characterized by absorption of lime salts, softening, and deformity. Generalized fibrocystic disease usually involves the shaft of the bones, but rarely the epiphysis. This disease is most common in early life and it does not produce much pain, anemia or weakness. Pathologic fracture is often the first indication of the trouble. Giant cell tumor may be

multiple These tumors frequently involve the diaphysis, absorbing the cortex and bulging into the soft tissues, but they rarely invade tissue outside the periosteum The patient's general health is seldom impaired Tuberculosis of the spine has been diagnosed as multiple myeloma, but roentgenograms and the clinical data, especially the absence of multiple bone lesions and of Bence-Jones proteinuria, make differentiation easy In the case reported, the posture and the extensive spinal involvement suggested spondylitis deformans as a possibility, but this was readily ruled out by urinalysis, roentgenograms and the discovery of anemia

#### ARTHROPLASTY OF THE ELBOW FOR ANKYLOSIS; RESECTION OF THE KNEE FOR ANKYLOSIS AND DEFORMITY

Case VI—A man, aged thirty, received an electric burn about ten months before examination, which had resulted in loss of the left arm at the middle of the humerus On examination the right elbow was ankylosed at  $150^{\circ}$ , and the patient used a fork, about 18 or 20 inches long, to assist him in eating The forearm was in pronation, and motion was nil, there were multiple scars about the elbow There was scarring of the left knee, the external hamstrings apparently were destroyed The sciatic nerve was injured, producing foot drop and a trophic ulcer of the heel The knee was held in flexion at about  $120^{\circ}$  Large wounds on the thigh had been covered with skin grafts The urinalysis and Wassermann test on the blood were negative, the hemoglobin was 70 per cent The tonsils were enlarged, but not definitely infected The roentgenologists reported destructive arthritis with ankylosis of the right elbow, and ankylosis of the left patella, apparently arthritis

The consulting surgeon advised arthroplasty of the right elbow for ankylosis, in order to permit the patient to pronate and supinate the forearm, and to get the hand to the mouth and head Operation was performed through a posterior incision and a double layer of fascia lata was inserted When this had been completed normal motion was secured The head of the radius was excised and fair pronation and supination demonstrated

The patient's convalescence was uneventful following arthroplasty, and two weeks later the left knee was resected through a transverse infrapatellar incision The ends of the bone were sawed off and the patella used as a graft Two wire nails were used to hold the parts in accurate approximation, the heads were allowed to extend out beyond the skin, and the wound was closed without drainage The nails were removed at the end of three weeks The cast was changed at the end of five weeks, and there was firm union clinically The patient was allowed to be up and about and to walk When he was dismissed from the hospital, eight weeks after operation, he was able to use the right elbow and to assist himself in eating his weight was good and his mental condition was greatly improved

This man presented a problem of reconstructive surgery in the adult which was solved by producing movement in the remaining upper extremity and resecting a stiff deformed knee joint so as to permit weight bearing. The result of each operation was entirely satisfactory. Ankylosing the knee in destructive arthritis resulting in marked deformity has been a useful operative procedure and it has also been helpful in chronic lesions such as tuberculosis of the knee. Many times the surgeon sees a patient who has been under medical care for many years and who is still disabled. By producing firm bony ankylosis the patient may be able to be up and about and to take up almost any useful occupation. In resections of the knee the use of nails is of definite benefit in holding the leg in good position although a plaster of Paris cast is also applied. Fixation must be continued until ankylosis has been definitely determined both clinically and roentgenologically. There is never any difficulty from the use of nails as they can be pulled out easily at the end of three weeks as if they were being pulled out of putty. As a rule the stitches are also removed at this time and the posterior half of the cast is used as a splint since it has the proper angle and saves unnecessary manipulation.

Following arthroplasty of the elbow acute flexion is carried out for a period of from ten to fourteen days and then active movement and gentle massage are begun. In most cases efforts are directed toward holding the flexion rather than the extension as a stable elbow with full flexion and slightly limited extension is preferable to a frail one.

## PLASTIC OPERATIONS ON THE EXTREMITIES

HUGH T JONES

### CONTRACTURE FROM BURN WITH EXTENSIVE ULCER IN POPLITEAL SPACE: EXCISION AND FULL-THICKNESS SKIN GRAFT

Case I—A man, aged thirty, came to the Clinic because of a large ulcer in the left popliteal space. Ten years previously he had been burned in a gasoline fire and the resulting ulcer had never healed. The ulcer measured



Fig. 679—Ulcer in popliteal space of ten years' duration due to old burn

5.5 by 8 cm. and it was surrounded by much scarring. It was obviously not badly infected but apparently had not healed because of the dense thick scars (Fig. 679). The knee was extended only with difficulty.

After a week of hot moist dressings and one day of hychlorite (1 : 35) dressings the ulcer was painted with phenol and sponged with 95 per cent alcohol under ether anesthesia in an effort to sterilize the tissue. Following this cauterization the ulcer including nearby scar tissue was excised. The scar beneath the ulcer was about 1 cm thick. In excising an attempt was made to reach vital tissue beneath and pliable skin on the edges of the ulcer. The excision made full extension of the knee possible without forcing. The wound was covered by vaselin gauze strips and a plaster cast was applied



Fig. 680—Appearance of skin graft applied to popliteal space two days after opening the cast

to maintain full knee extension. On the fourth day after operation a window was cut in the cast over the wound which appeared fresh and clean. Hychlorite (1 : 7) dressings were applied for a day and then under gas anesthesia the skin defect in the popliteal space was accurately stitched in to cover the wound in the popliteal space. The

wound in the buttock was closed with figure of eight silkworm gut stitches after the skin had been undercut and "piecrust" incisions made in the skin of the buttock. The graft was covered with a copious dressing of fluffed gauze and was bandaged on with moderate pressure. A plaster cast was then applied to maintain rest and exert moderate pressure on the graft. On the eleventh day, the graft was exposed through a window in the cast, and was found to be in an excellent state of nutrition (Fig 680). Pressure on the graft was maintained for another week. Two small areas sloughed but healing ensued without trouble. A letter from the patient dated March 3, 1927 stated that he was at work and that his leg was in good shape (Fig 681).



Fig 681—Appearance of graft to popliteal space four months after operation

*Comment*—This case illustrates one use of the free full-thickness skin transplant. Success depended principally on obtaining an aseptic field, preliminary excision of scar tissue to reach the deep lymphatic and blood supply, and the maintenance of moderate pressure on the graft without disturbing it for about ten days. Normally there is almost continuous motion of the skin in the popliteal space and the full thickness skin graft was especially adaptable to this locality because of its pliability. Thinner grafts are not so suitable because more scarring results and they are less pliable.



# CONGENITAL WEB FINGERS: AN ADDITION TO DIDOT'S OPERATION FOR SYNDACTYLISM

Case II—May 24 1926 an eleven months old boy was brought to the Clinic because of congenital syndactylism the webbing involving the four fingers of the left hand. The thumb and little finger were well developed but

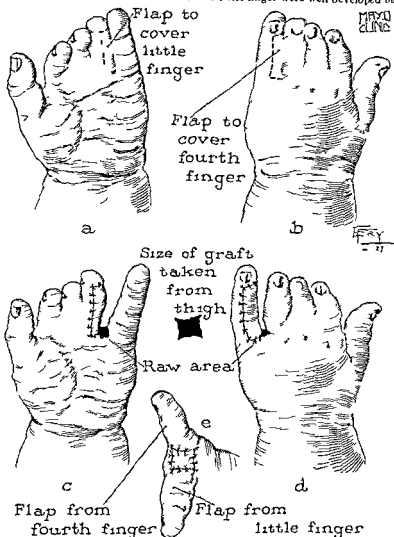


Fig 682—An addition to Didot's operation for syndactylism the full thickness skin graft *a* and *b* indicate proposed flaps to be used after separation of fingers *c* and *d* indicate use of flaps after separation of fingers leaving area in crotch uncovered by skin *e* shows full thickness skin graft used to cover area in crotch

the intervening fingers were improperly developed. It was thought to be too early to carry out surgical procedures and the child was dismissed temporarily. March 27, 1927, he was brought back for observation and because of deviation of the distal phalanx toward the smaller intervening fingers it seemed best to separate the fifth finger at once.

The Didot's plastic operation was performed (Fig. 682). A considerable defect was left at the crotch between the fifth and fourth fingers. To close this by suture meant considerable tension on the sutures and would have limited the spread of the fingers considerably. The free full thickness skin transplant was used to cover the defect. The graft was cut from the thigh



Fig. 683—Appearance of the hand on the nineteenth day after operation.

to correspond to a rubber tissue pattern of the defect in the crotch of the fingers. I have since thought that the skin on the inner side of the arm would have been more suitable in texture for the crotch of the finger. Following the suture of the finger flaps according to Didot's operation (Fig. 682 a b c d) the full thickness graft was stitched into place (Fig. 682 c). The field of operation was covered by fluffed gauze which was made to exert moderate pressure on the graft. The fifth finger was spread from the others and held thus by a splint. On the eleventh day when the dressings were removed the graft was in excellent condition. It allowed a spread in the fingers that I am confident would be lacking had not the full thickness graft been used. Figure 683 shows the appearance of the hand nineteen days after the operation.

*Comment*—In dealing with multiple webbed fingers it is usually advisable to attack one web at a time. If more than one web is severed at a time, the nutrition of the flaps is likely to

suffer The opportune time for operation is also to be considered It is well to wait until the fingers are large enough to be dealt with surgically. After all, our surgical methods are relatively crude and undue trauma on a very small hand may result in scars which cause marked deformity. By the time the child is six years old, the operation offers less technical difficulties In the case described, early operation was thought advisable because the fifth finger was being bent toward the smaller deformed neighbors

#### LOSS OF TENDO ACHILLIS AND OVERLYING SOFT TISSUES BY TRAUMA; PLASTIC RECONSTRUCTION

Case III.—A boy of twelve was brought to the Clinic June 4, 1927, twelve days after a severe laceration of the right tendo achillis and overlying

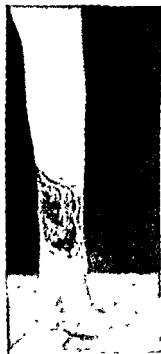


Fig 684 —Loss of tendo achillis for space of 5 cm Appearance following excision of slough

skin which occurred in a motorcycle accident An attempt had been made to resuture the tendon but sloughing had destroyed it entirely. There was

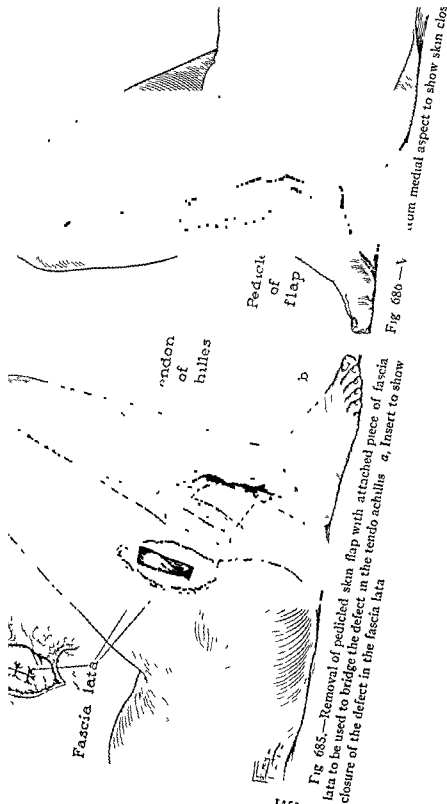


Fig 685.—Removal of pedicled skin flap with attached piece of fascia lata to be used to bridge the defect in the tendo achillis a, Insert to show closure of the defect in the fascia lata

Fig 686 —v

also considerable sloughing of neighboring tissues but no apparent signs of infection. Under a general anesthetic the sloughing skin, subcutaneous tissues and tendo achillis were excised. The dressings were moistened with bichloride solution (diluted 1:10) every three hours and were changed completely three times a day. The wound remained clean in appearance (Fig. 684) and June 16 a pedicle skin graft was removed from the right

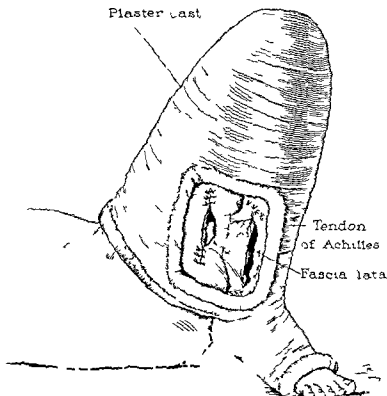


Fig. 687.—View from lateral aspect to show partial closure indicating fascial strip sewed into place to bridge defect in heel cord. The fascial strip was not separated from the pedicled flap to the degree shown in the drawing. The foot was placed in equinus to dispense with tension on the fascial graft.

thigh posteriorly cut by a pattern to fit the defect on the right leg when the heel was held close to the buttock. In cutting loose the pedicled flap from the thigh a piece of fascia lata was excised leaving the fascia attached to the skin in such a manner that when the flap of skin from the thigh was placed

the field of operation on the tendon and close the wounds except for a strip on the thigh and one on the leg (Fig 687) The open areas were covered with vaselin gauze The foot was placed in equinus when the fascia was sutured to bridge the tendon defect, and a plaster cast was applied extending from the groin to the toes, holding the right heel close to the buttock. A window was cut in each side of the cast to observe the field of operation The

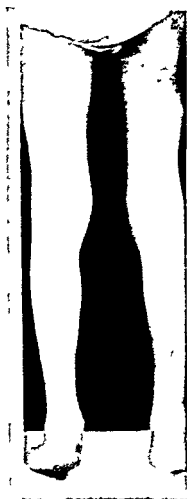


Fig 688—Photograph two months after operation showing patient standing on tip-toes

pedicle was cut in two stages on the eleventh and twenty third days after operation The flaps lived except for an area 1 by 2.5 cm which rapidly filled in Some drainage developed from the region of the fascial transplant but no signs indicating infection of the wound were evident The pedicle was partly severed on the eleventh day and completely severed on the twenty third day Following this the wound was closed without drainage A small slough appeared in the line of suture, and a small part of the fascial trans

plant was exposed resulting in a small slough. As plenty of skin was available the sloughs were trimmed away and July 20 a secondary closure was made. A bivalved cast was used to support the foot in the equinus position. This was removed daily for active exercise beginning about a month after the transplanting operation. By August 5 it was evident that the reconstructed heel cord was functioning. The atrophied muscles of the calf gradually developed more power and August 18 the photograph was taken which shows the boy standing on tip toes (Fig 688). Sufficient time has not elapsed for complete return of power but the strength has been increasing rapidly.

*Comment*—Loss of the heel cord and with it the use of the calf muscles causes serious disability. The method here described may be found useful in other cases. The necessary acute flexion of the knee caused only moderate discomfort for a few days. More trouble might have been encountered if the patient had had a fat heavy thigh and leg.

## UNUSUAL SURGICAL LESIONS OF THE URINARY TRACT

VERNE C HUNT

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UNUSUAL surgical lesions of the urinary tract may be recognized through proper interpretation of the data obtained by thorough examinations. The clinical recognition of anatomic anomalies of the tract has become possible and the extent of pathologic change is usually readily determined. Exact methods of diagnosing lesions of the urinary tract are available and indispensable in accurate differential diagnosis. The symptoms of intra abdominal disease and those of disturbances of the urinary tract are often sufficiently atypical not only to lead to confusion in diagnosis, but also to be entirely misleading. This is particularly true of anomalies of the urinary tract.

### ECTOPIC PYONEPHROSIS WITH STONES

Case I—A man, aged fifty seven, came to the Clinic June 6, 1927 on account of general weakness. He had lost about 15 pounds, but still weighed 150. His physician had found a great many pus cells in the urine. There had been some irritability of the bladder recently.

There was a soft doughy mass in the lower part of the abdomen which seemed to be a distended bladder. The systolic blood pressure was 134 and the diastolic 70. The specific gravity of a 1,200 c c specimen of urine was 1.022, there was a moderate amount of albumin, no sugar, a few red blood cells and pus cells graded 4. There was no residual urine, the mass did not disappear on the passage of the catheter. The phenolsulphonephthalein return was 55 per cent in two hours, the blood urea was 28 mg. for each 100 c c. The hemoglobin was 65 per cent, the erythrocytes numbered 3,670,000, and the leukocytes 7,400. The blood Wassermann test was negative. Roentgenologic examination disclosed a shadow at the level of about the second lumbar vertebra (Fig. 689). At cystoscopic examination there was no evidence of diverticulum or other intravesical lesion except slight cystitis, however, a thick purulent secretion came from the left ureter. A differential test of renal function was normal for the right kidney but there was no return of the dye from the left. In the pyelogram (Fig. 689) the left ureter appeared short, dilated, and tortuous with little of the medium extending beyond the site of the shadow which was thought to be that of a stone in the pelvis of an ectopic left kidney.



At operation June 15 1927, through a low median line incision, the left ectopic kidney was removed extraperitoneally. The mass was about 12.5 cm. in diameter and was little more than a pyelonephrotic sac containing



Fig. 689 —A short dilated tortuous ureter leading to the shadow of the stone in the ectopic kidney



Fig. 690 —The ectopic kidney with a large stone filling renal pelvis complete destruction of kidney tissue

purulent material and one stone 3 by 2 cm. in diameter (Fig. 690). There was an anomalous blood supply of numerous vessels. The ectopic kidney

lay entirely below the rim of the pelvis. Practically all of the renal tissue had been destroyed. Convalescence was entirely satisfactory and the patient was dismissed from the hospital on the sixteenth day.

*Comment*—While the symptoms of a diseased ectopic kidney are variable, pain usually predominates on account of the obstruction of the ureter and pelvis by anomalous or accessory blood vessels, or on account of stones. This case illustrates the absence of subjective symptoms directly referable to the kidney. While the clinical diagnosis in this case was that of stone in the pelvis of an ectopic kidney, the possibility of stone in a large diverticulum of the bladder with marked infection of the left kidney was considered. However, the short tortuous ureter extending to the shadow, the purulent secretion from the left ureter, and absence of function of the left kidney with the palpable mass which did not recede with drainage of the bladder was sufficient to establish the diagnosis of a stone in the pelvis of an ectopic kidney. In this particular instance the low median line incision afforded excellent extraperitoneal access to the kidney. This is the incision of choice in approaching a pelvic kidney. Removal of an ectopic kidney lying above the brim of the pelvis is best accomplished through a rectus incision, which likewise facilitates the extraperitoneal operation. Nephrectomy is necessary for hydronephrosis, pyonephrosis or lithiasis in an ectopic kidney.

In a recent review of a series of cases of ectopic kidney, it was found that many operations were performed for the removal of the appendix, gallbladder, and ovaries because of symptoms produced by an unrecognized ectopic kidney. The anomalies of the upper portion of the urinary tract, particularly ectopic kidney, should be borne in mind in differential diagnosis when abdominal symptoms are atypical. It is noteworthy that in most cases of anomaly of the kidney there is an anomalous blood supply, which may produce mechanical obstruction and intermittent or progressive hydronephrosis. The ectopic kidney is susceptible to various pathologic processes. The abnormal position of the kidney, particularly if it is in the pelvis, the fixation and the associated anomalous and multiple blood vessels, provide conditions

under which drainage is poor. Atrophy and infection often occur with hydronephrosis and lithiasis frequently supervenes. The clinical diagnosis requires competent urologic examination.

#### HYPERNEPHROMA PROGRESSING ALONG THE URETER

**Case II**—A man aged fifty-eight came to the Clinic June 20, 1927 on account of hematuria which had first appeared *seventeen months previously*. It had lasted for three weeks, reappeared eight months later and since then has been continuous. There were no other subjective symptoms. After urologic examination elsewhere neoplasm of the right kidney was diagnosed.

The systolic blood pressure was 116 and diastolic 80. A twelve hour



Fig. 691.—Filling defect involving the upper calix and major portion of the renal pelvis.

75 per cent the erythrocytes numbered 4,030,000 and leukocytes 7,000.

was approximately normal. In the pyelogram (Fig. 691) seen involving the upper calix and major portion of the pelvis, the ureter was not completely outlined. On account of the filling defect and hematuria, papillary epithelioma of the right renal pelvis was diagnosed and operation advised.

At operation July 14 the right kidney was found to be about normal in size and consistency, however the pelvis was dilated and contained a soft

doughy purplish mass typical of papillary epithelioma of the renal pelvis and the ureter appeared to be involved. The vascular pedicle was ligated the upper third of the ureter freed and the kidney was brought outside the wound still attached to the ureter around which the wound was closed in order to remove the kidney and ureter intact through an anterior incision. The patient was turned on his back and through a low median anterior incision extraperitoneal exposure of the ureter was made. As the primary lesion of the kidney was thought to be papillary epithelioma and as such a lesion frequently extends to the mucous membrane of the bladder adjacent to the ureteral orifice it seemed advisable to resect the bladder adjacent to the right ureteral orifice with the ureter. The ureter was about 1 cm in



Fig 692 —Hypernephroma of lower pole of kidney involving the entire ureter to bladder

diameter and contained tumor throughout its length. After the bladder was resected and the lower two thirds of the ureter was freed traction on the kidney from without the posterior incision delivered the kidney entire ureter and resected portion of the bladder intact as a single specimen. Not until the specimen was opened and examined was the nature of the lesion revealed. It was true hypernephroma extending along and involving the entire ureter (Fig 692). Convalescence was entirely satisfactory and the patient was dismissed from the hospital on the twenty first day.

*Comment* —It has been noted in the Clinic that hypernephroma comprises about 75 per cent of malignant tumors of the

about three times as large as normal the result of a large hypernephroma involving the upper half of the kidney which had destroyed about 70 per cent of the renal tissue. The patient did not improve after operation and death occurred on the fifth day. At necropsy a hypernephroma of the right kidney, 1.5 by 3.5 by 3 cm was found (Figs 693-695). Except for involvement of the left suprarenal metastasis was not found. Death was due to general peritonitis and ileus secondary to gangrene of two loops of small intestine.

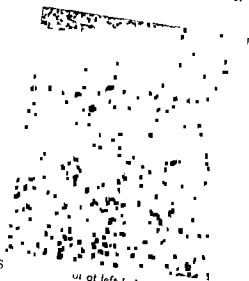


Fig 695—S

cut of left kidney shown in Figure 693

*Comment*—At operation or necropsy small hypernephroma have occasionally been found associated with the primary tumor in one kidney. However, the finding of bilateral hypernephroma is exceedingly unusual and a cursory review of the literature and text books on pathology emphasizes the infrequency of the bilateral lesion. It seems that the presence of hypernephroma in both kidneys is a coincidence and that one bears no relationship to the other on the basis of metastasis. The differential test of renal function in this case indicated approximately normal function of the right kidney and a pyelogram was not made in view of the urologic observations of the left kidney.

#### PAPILLARY EPITHELIOMA OF THE URETER

*Case IV.*—A man aged sixty seven came to the Clinic August 5 1927 on account of hematuria which had appeared one year before. The hematuria

had been continuous but was unaccompanied by symptoms other than moderate irritability of the bladder and some frequency. There was marked arteriosclerosis and a sensation of fulness in the region of the right kidney. The systolic blood pressure was 140 the diastolic 70. The urine contained a large amount of blood. The blood urea was 18 mg for each 100 c.c. At cystoscopic examination hemorrhagic urine was seen coming from the right



Fig. 696.—Papillary epithelioma of the ureter. Hydronephrosis due to an accessory vessel to the lower pole. Kidney, ureter, and segment of bladder removed intact.

ureteral meatus. In making a right pyelogram the medium did not pass up the ureter more than 2 cm. and the film showed only a marked filling defect of the intramural portion of the ureter. A differential test of renal function showed that the left kidney was normal and the right functionless. Possible papillary epithelioma of the lower portion of the ureter was diagnosed and operation was advised. The indications were clear for nephro-ureterectomy.

August 8, 1927 through a low median anterior incision extraperitoneal exposure of the lower third of the ureter was made. Throughout its lower third to the bladder, the ureter was about 1 cm. in diameter, solid in consistency from the tumor, purplish in color, quite characteristic of papillary epithelioma. A segment of the bladder adjacent to the ureteral orifice was excised with the lower third of the ureter which was freed. The ureter and the attached segment of the bladder were wrapped in gauze and tucked up toward the kidney.



Fig. 697.—Primary papillary epithelioma of lower half of ureter.

After reconstructing the bladder and closing the incision, the patient was turned on his side and through a posterolateral incision, the kidney with the entire ureter and segment of the bladder were removed as one specimen (Figs. 696-697). There was marked hydronephrosis not the result of the obstructing tumor, but of obstruction from an accessory vessel to the lower pole at the ureteropelvic juncture. The lesion proved to be primary papillary epithelioma of the ureter involving the lower half. The kidney was little more than a

hydronephrotic sac the upper part on of the ureter renal pelvis and calices were not involved by the tumor. Convalescence was uneventful.

*Comment*—Papillary epithelioma of the renal pelvis and ureter occurs with relative infrequency, as the parenchyma of the kidney is the usual site of tumor formation. Primary epithelioma of the renal pelvis occurs in from 1 to 5 per cent of cases of miscellaneous renal tumors. From January 1, 1910 to May 1, 1927, 318 malignant tumors were removed by nephrectomy at the Clinic of which twenty three were primary epithelioma of the renal pelvis an incidence of 7.2 per cent giving a ratio of approximately one primary epithelioma of the pelvis to fourteen of the renal parenchyma. While the twenty three primary epitheliomas of the renal pelvis were all of the squamous cell type, eight were sessile and fifteen were distinctly papillary this case belongs to the latter group.

Microscopic examination of the cells of papillary epithelioma of the renal pelvis furnishes the basis for differentiating the sessile type of tumor and the papillary type. Although these tumors have the same genesis they differ materially in degree of malignancy and manner of growth and extension. Sessile epithelioma is highly malignant while the papillary epithelioma is relatively benign. Sessile epithelioma progresses and extends by invasion of perirenal tissues the renal vein and so forth, and metastasizes remotely, while the papillary type progresses by direct extension along the mucous membrane of the calices ureter, and bladder.

Recently I reported in detail the fifteen cases of papillary epithelioma of the renal pelvis observed in the Clinic, and it was noted that in eleven of the cases, extension to the bladder adjacent to the ureteral orifice had occurred before operation or after operation when nephrectomy alone or nephrectomy and partial ureterectomy had been performed. It is extremely unusual for other types of malignant tumors of the kidney to progress in this manner. When papillary epithelioma does occur it is usually primary in the renal pelvis. In but one of the fifteen reported was the ureter the primary site for development, and in that instance the lesion was primary at the ureteropelvic



juncture Extensive primary ureteral involvement, as in this case, is extremely unusual The anomalous blood vessel to the lower pole producing hydronephrosis is of more than passing interest. Anomalous blood vessels producing hydronephrosis associated with primary epithelioma have not been noted previously in the Clinic

The method of progression of papillary epithelioma necessitates more radical procedures than simple nephrectomy used in the surgical treatment of other types of renal malignancy. Resection of the bladder adjacent to the ureteral orifice and complete nephro-ureterectomy is necessary to insure against recurrence

### EPITHELIOMA IN A DIVERTICULUM OF THE BLADDER

Case V—A man, aged fifty nine, came to the Clinic November 25, 1925 on account of difficulty in voiding, and frequency and inability to empty the bladder For several months the patient had noticed a mass in the right lower part of the abdomen which had varied in size The urine had been cloudy for months but became clearer at times He had lost 20 pounds in weight in the preceding six months

A large soft cystic mass filled the lower half of the abdomen which was considered to be a hugely distended bladder The systolic blood pressure was 116 the diastolic 80 A twelve hour specimen of 1,200 c c of urine contained many blood cells and a great deal of pus The blood Wassermann test was negative and the urea 62 mg for each 100 c c of blood The hemoglobin was 46 per cent the erythrocytes numbered 3,020,000 and the leukocytes 10,300 Roentgenologic examination of the kidneys ureters, and bladder was negative The patient was sent to the hospital and measures for decompression of the bladder were instituted After two weeks of permanent urethral drainage the blood urea dropped to 36 mg A cystogram at this time showed a huge diverticulum of the bladder The patient's general condition was poor, and after three weeks in the hospital, when the blood urea had gone as high as 122 it seemed advisable to institute suprapubic drainage This was done December 21, under local anesthesia The patient failed to improve, became progressively worse, and death occurred six days later

At necropsy there was a large diverticulum emptying into the right wall of the bladder (Fig 698) The diverticulum in its contracted state was as large as the bladder Judging from the size of the abdominal mass and the cystographic data the diverticulum must have been at least twice the size of the bladder previous to drainage It was relatively thin walled in comparison to the bladder and its walls contained no muscle fibers There was a large foramen of communication between the diverticulum and bladder, fully 2 cm in diameter The right ureter, which was double, united at the bladder, entered the diverticulum and a true interureteric bar extended from



Fig 698 —Bladder and diverticulum

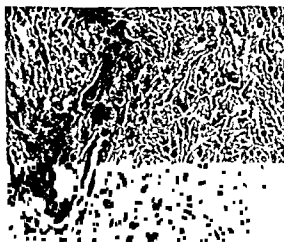


Fig 699 —Section of epithelioma in the diverticulum shown in Figure 698



## PUNCH OPERATION FOR PROSTATIC OBSTRUCTION

HERMON C BUMPUS, JR

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WHEN symptoms of urinary obstruction are associated with physical data that do not indicate sufficient prostatic hypertrophy to explain their severity a painstaking urologic examination is imperative before prostatectomy is recommended

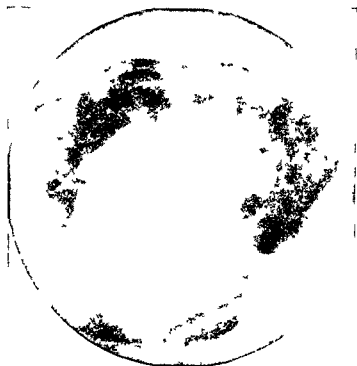


Fig 700 —Cone shaped bladder typical of prostatic obstruction of short duration (one to two years) Trabeculation causes slight irregularity of outline

If the prostate, as palpated through the rectal wall, is sufficiently enlarged to explain the symptoms complained of, a cystoscopic examination may not be necessary, and should be avoided if possible, as the passage of a rigid cystoscope through a tortuous urethra may produce considerable trauma

Roentgenologic examination of the urinary tract will show any complicating calculi and, if made after the bladder is filled with an opaque solution such as silver or sodium iodid will reveal diverticula. Cystograms will give an excellent index to the duration of the urinary obstruction by the amount of bladder deformity revealed. Thus, if there is but slight irregularity in the outline of the bladder one may be confident that the obstruction has been of comparatively short duration. If the trabeculation



Fig 701 —Marked cone shaped deformity extreme irregularity of outline due to trabeculation the result of many years of prostatic obstruction

is well marked and many cellules are present the obstruction has probably been of much longer duration (Fig 700). In cases of urinary obstruction of several years' duration there is usually a typical cone-shaped (Fig 701) deformity with possibly one or two medium sized diverticula that may or may not empty. With this information at hand and a knowledge of the amount of residual urine present, little more can be learned by cystoscopy.

When the urinary symptoms are in excess of those that might be expected from the degree of hypertrophy of the prostate determined by rectal palpation and when the cystogram shows only negligible changes, cystoscopic examination is necessary to determine whether the symptoms are the result of hypertrophy confined to the median lobe of the prostate, contracture of the neck of the bladder, frequently termed bar formation, or of chronic prostatitis that has produced enough enlargement of the



Fig 702—Irrregularity of outline of bladder due to trabeculation resulting from cord lesion *The bladder remains spherical in outline*

gland to cause partial obstruction of the urethra. Such disproportionate symptoms may also develop from some pathologic change in the nervous mechanism of the bladder, most frequently resulting from disease of the spinal cord such as tabes or spinal cord tumor, or may sometimes be associated with spina bifida occulta. In such cases the urethral sphincter is usually relaxed, the bladder is atonic, and there is marked diminution of sensation in the posterior urethra (Fig 702).

General prostatic fulness and dilatation of the prostatic ducts from which purulent prostatic fluid exudes are usually present in subacute prostatitis the symptoms of which are due as much to the inflammation as to the small amount of obstruction. In this condition the removal of a portion of the gland just below the sphincter and of the inflamed mucous membrane seldom affords relief and often aggravates the condition. If such a procedure is deemed advisable because of the amount of residual urine present it is best to wait until the acute inflammation has subsided under appropriate local treatment. When the condition has become chronic and scar tissue has replaced the inflammatory area then satisfactory results may be expected from the removal of a portion of the contracted neck of the bladder. This operation through a suprapubic incision presents considerable difficulty as the gland cannot be shelled out satisfactorily because of the cicatricial changes; neither does it seem logical to remove the entire gland to correct a contracture of the neck of the bladder. In these cases and in those in which adenomatous hypertrophy is confined to the median lobe of the prostate the punch operation finds its greatest field of usefulness.

The punch operation devised by Young is performed by engaging the hypertrophied neck of the bladder in a fenestra in an endoscope, a cylinder of a diameter slightly smaller than that of the endoscope, with a sharpened edge is then thrust in so as to cut through the obstructing portion of the gland.

This instrument has two rather serious disadvantages. Because of bleeding it is impossible to take more than the initial bite under vision, and there is no method of producing hemostasis after the operation is completed. The first objection is not so serious as in trained hands the position of the instrument can be fairly accurately determined; however, cases are on record in which the mucosa of the bladder was removed instead of the prostatic enlargement with resulting penetration of the inside. The lack of hemostasis has prevented the operation from becoming popular. So serious is the bleeding at times that in all large series of cases reported there are occasional instances in which

subsequent suprapubic cystostomy has been necessary to control the bleeding.

Some years ago Caulk devised a cautery punch modeled on the original Young punch, but with the cutting blade of the cylindrical knife made of platinum and heated by an electric current to white heat to cauterize as it cut. This removed one of the objections to the operation and has resulted in making it more popular.

In a review of the results of a series of cases in which I operated with this instrument, immediate hemostasis was usually found to be adequate, but delayed bleeding occurred when the scar came away and, although it was never serious, it was often rather

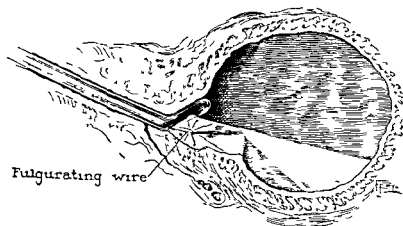


Fig 703.—Electrocoagulation at bleeding points

alarming to the patient. However, a more serious complication was discovered, pyelonephritis developed in a large number of cases from ascending infection resulting from delayed healing of the cauterized area in the bladder.

Formerly when knife punch was used convalescence lasted but a few days; many patients operated on by the cautery method have been confined to the hospital several weeks.

In an endeavor to perfect this procedure the Braasch cystoscope was modified so that it embraced the principle of the Young punch, but also made it possible for the operator to see exactly what to excise, and the procedure could be repeated as many times as necessary. With this instrument it is possible



to remove several grams of tissue during the operation. The instrument is removed as soon as the necessary amount of tissue is excised, and is immediately replaced by a direct cystoscope, through the catheter guide of which a small electrode is inserted. Under vision the separate small arteries are found as they spurt and are closed by electrocoagulation (Fig 703). They are usually not numerous and it is only a short time until irrigating fluid becomes perfectly clear.

The obstruction being removed the patient voids freely and he is seldom in the hospital longer than from five to seven days.

This procedure does away with the insertion of the large urethral catheter formerly employed to help produce hemostasis which frequently caused severe urethritis with its complications, such as epididymitis and pyelonephritis.

We have treated many cases by this method satisfactorily curing complete urinary retention or lesser degrees of retention. The operation is most useful for patients in the fifties and early sixties. If there is from 3 to 7 ounces of residual urine, some form of relief is imperative and yet it seems inadvisable to remove the entire gland. Prostatectomy may be necessary later when further hypertrophy of the gland has taken place but in my experience this is exceptional.

I wish to emphasize the fact that the success of this procedure depends on the careful selection of cases. If enlargement of the lateral lobe is marked and there is considerable rectal enlargement the punch operation is contraindicated but if the obstruction is confined to the median lobe of the prostate the results are gratifying to both patient and operator.

REMOVAL OF TUMOR OF THE CHEEK AND TEMPORAL REGION WITH SECONDARY PLASTIC OPERATION; EPITHELIALIZED FLAP FROM THE FOREHEAD TO RECONSTRUCT THE LOWER LIP AND CHEEK; REGENERATION OF A LARGE PORTION OF THE LOWER JAW-BONE SECONDARY TO ACUTE OSTEOMYELITIS; BONE GRAFT FROM THE CREST OF THE ILIUM FOR RECONSTRUCTION OF THE ASCENDING RAMUS AND TWO-THIRDS OF THE LOWER JAW-BONE; LARGE FIBROSARCOMA OF THE HYPOPHARYNX

GORDON B NEW

REMOVAL OF TUMOR OF THE CHEEK AND TEMPORAL REGION  
WITH SECONDARY PLASTIC OPERATION

Case L—A woman, aged twenty four, came to the Clinic August 1 1925 with a tumor of the left cheek. Three months before she had first noticed a



Fig 704 —Tumor of the left cheek



Fig 705 — After removal of the tumor with surgical diathermy (Note exposed bone of the left margin of the orbit and malar region)



Fig 706 — Same case eighteen months after plastic operation. Tissue brought down from the forehead. A full thickness skin graft area utilized on the cheek

small nodule in the left malar region which grew larger rapidly. Five weeks and a half previous to her examination here a diagnosis of sarcoma was made and the growth was treated with radium; however, the tumor continued to grow larger and a plaster had been applied.

At examination there was a large ulcerated cauliflower like growth about 5 cm. in diameter, in the left malar region involving the lower eyelid and outer canthus. The tumor bulged into the lower and outer part of the orbit (Fig. 704). There were numerous small nodes in the parotid and cervical regions. Clinically the growth appeared to be a rapidly growing sarcoma.

August 6 the tumor was destroyed by surgical diathermy without injury to the eye and radium was applied to the parotid and cervical regions. 4,000 mg. hours were used with 2 mm. of lead screening. Distance was maintained by the interposition of a wood block 2.5 cm. thick. Microscopically the tumor was diagnosed foreign body giant cell tumor.

The patient returned April 21, 1926. A sequestrum was removed from the lower and outer margin of the orbit along with the outer surface of the malar bone (Fig. 705). There was no recurrence of the original tumor. July 16 a flap was elevated from the forehead with a pedicle in the left temporal region and a week later this was brought down to fill in the lost area of the lower eyelid and cheek. A full thickness skin graft was inserted in the forehead to cover the area from which the flap had been taken for the cheek. The last stage was performed August 9 when the pedicle was returned to the forehead (Fig. 706).

*Comment*—Clinically the lesion appeared to be a fulminating type of malignant tumor which had been present for only three months. Although tissue examined by the pathologist showed a foreign body giant cell tumor, it is possible that the plaster and the radium treatment were factors in producing this microscopic picture.

In correcting deformities, resulting from the removal of malignant tumors about the face, it is best to wait from six months to a year before performing any plastic operation in order to avoid the possibility of recurrence underneath the flap. If the flap is brought down at the time of the first operation and thickening occurs in the flap later, it is difficult to decide whether or not it is a recurrence of the growth.

#### EPITHELIALIZED FLAP FROM THE FOREHEAD TO RECONSTRUCT THE LOWER LIP AND CHEEK

*Case II*—A woman, aged forty, came to the Clinic March 22, 1926. Her first husband had died from what was probably paresis. Her chief complaint was scarring and loss of the left lower lip and cheek, the result of a burn six



Fig. 700 —Loss of the left lower lip and cheek with marked scarring the result of a burn



Fig. 703 —The lower lip and cheek reconstructed by a double epithelialized flap brought down from the forehead. A full thickness skin graft used for lining. Full thickness skin graft also used to fill in the area on the forehead tissue from which had been utilized to reconstruct the lip and cheek.

months before. She was subject to epileptic attacks and had fainted and fallen against a radiator. When she regained consciousness her face and lower lip were badly burned. A large portion of the lower lip and part of the cheek sloughed away, several teeth and a sequestrum from the lower jaw had been removed (Fig. 707).

Examination showed extensive scarring with loss of almost the entire lower lip and the left angle of the mouth. A scar about 7.5 cm. long and 3.75 cm. wide, extended up onto the cheek. The patient had syphilis of the central nervous system. She was given antisyphilitic treatment in the Section on Dermatology and operation was deferred until the blood was in proper condition.

April 29, a flap was elevated from the forehead with a pedicle in the region of the left zygoma and the distal end extending to the right of the median line. A full thickness skin graft was inserted under the distal third of the flap. In successive stages, the flap from the forehead was elevated and sutured in place on the cheek and lower lip and a full thickness skin graft was used to fill in the area on the forehead. It was necessary to use the remaining part of the vermilion margin to stretch over the skin to make a vermilion margin for the left side of the lower lip. Mucous membrane from inside the left cheek was also used for this purpose (Fig. 708).

*Comment*—The forehead is a satisfactory place from which to take a flap for the reconstruction of the lost portions of both the nose and cheek. The temporal region is the best site for the pedicle when the flap is to be turned down to the lip or cheek. It is necessary to have the distal portion, which is to reconstruct the lip, epithelialized, and this requirement is met most satisfactorily with a full-thickness skin graft obtained from the inside of the arm. The use of a full-thickness skin graft to replace the area in the forehead is also advisable, the end-result in these cases being much better than if a Thiersch graft is employed.

#### BONE GRAFT FROM THE CREST OF THE ILIUM FOR RECONSTRUCTION OF THE ASCENDING RAMUS AND TWO-THIRDS OF THE BODY OF THE LOWER JAW-BONE

Case III.—A man, aged forty six, came to the Clinic February 15, 1927, for correction of the loss of the greater portion of the right lower jaw. Nineteen months before, while working in a mine his jaw was fractured. Following this, infection with much loss of tissue occurred. Eleven months later, the greater part of the right side of the inferior maxilla was removed as sequestrum. He had been using a prosthetic appliance without satisfaction.

At examination it was seen that the ascending ramus and two thirds of the body of the mandible on the right side had been lost. The lower jaw was displaced to the right so that it was of no use in mastication (Fig. 709). A

formed back of the isthmus of the thyroid. There was very little reaction from this operation therefore four days later, May 21, through an incision in the left submaxillary and cervical regions anterior to the sternomastoid muscle the tumor was exposed and removed without making an opening into the pharynx. The growth measured 6.5 by 5 by 3 cm and was attached to one of the cervical vertebrae anteriorly and laterally, so that considerable bleeding occurred at this point which was controlled by suturing an iodoform gauze pack in the wound. Microscopically the tumor was fibrosarcoma (Figs 714, 715).



shown in Figure 714

The patient was fed by a Rehfuess tube through the nose. Recovery was uneventful; the pack was removed in a week and the tracheotomy tube a day later. The patient was dismissed June 9, with the wound in the neck completely healed and the tracheotomy wound almost closed. There was no reaction in the pharynx.

*Comment*—Mixed tumors or fibrosarcomas are the tumors most commonly found in this region. Many of them can be removed through the mouth, but the larger ones are better removed through the outside of the neck on account of the bleeding that occurs and the attachment to the periosteum of the

vertebræ, as in this case. The preliminary tracheotomy is essential and eliminates mortality in this group of cases. If one waits until obstruction occurs after operation and then opens the trachea, bronchopneumonia is more likely to follow. In this case the pharynx was not opened and convalescence was uneventful.





## UNILATERAL EXOPHTHALMOS IN GRAVES' DISEASE

JOHN DEJ PEMBERTON AND WILLIAM W SAGER

Case I—A married woman, aged thirty eight, gave a history of having been ill for four months with symptoms of marked prominence of the right eye, nervousness tremor, cardiac palpitation, tachycardia, dyspnea, insomnia, loss of strength and weight and intolerance to heat. Weight decreased from 135 to 125 pounds, although the appetite remained good.

The patient was underweight and nervous and the neck was slightly enlarged. The thyroid gland was found to be definitely enlarged; the enlargement was symmetric, adenomas were not discovered. The most striking



Fig 716 —Photograph taken at time of examination

feature of the examination was marked proptosis of the right eye (Fig 716). There was a definite tremor and marked weakness of the quadriceps muscles. The skin was moist. The systolic blood pressure was 160 and the diastolic 80. The pulse was 136. The blood Wassermann test was negative. The blood count was normal. Examination of the urine revealed nothing abnormal. The basal metabolic rate was +72.

The patient was admitted to hospital and given iodine as Lugol's solution 10 minims three times a day. Ten days later the basal metabolic rate was +68. Eighteen days after admission to hospital and the institution of iodine treatment subtotal thyroidectomy was performed. Each lobe was found enlarged to about four times the size of a normal lobe. A double resection was made and the isthmus removed, the posterior mesial part of each lobe being preserved amounting to about one-fifth of a normal sized lobe on the right side of the trachea and to about one fourth of a normal lobe on the left side. Pathologic examination of the gland revealed a hypertrophic parenchymatous thyroid. The resected part weighed 78 gm.

Convalescence was uneventful. The patient was dismissed from the hospital on the seventh day and from the Clinic shortly thereafter. Lugol's solution was given (30 minims a day in three doses) during the period in the



Fig. 717—Photograph taken about two years after operation (same case as Fig. 716)

hospital but was decreased to 10 minims once a day after dismissal. On dismissal from the Clinic the patient was instructed to continue taking 10 minims daily for two months.

Twelve weeks after the operation the patient wrote in response to an inquiry: "My operation was just three months ago; my eye looks much better."

In a recent communication the patient states that she is in excellent health. She enclosed her photograph (Fig. 717) taken about two years after the operation.

**Case II.**—A man aged fifty-six complained of a variable amount of swelling of the left eyelid which had been continuously present for eighteen months. This was the first symptom the patient had noticed. He had suf-

fered from nervousness, tremor, palpitation, loss of weight, and heat intolerance for six months. Four months previous to coming to the Clinic he noticed that the left eye was more prominent than the right, and this had grown gradually more noticeable. There was no pain in the eye, but considerable epiphora and itching.

The patient was 6 feet tall, and weighed 187 pounds. The skin looked rather hyperemic. The thyroid was enlarged, the greater enlargement being on the right side. There was marked proptosis of the left eye with edema of the lid (Fig. 718). The appearance of the right eye was normal. There was slight peripheral vascular sclerosis. Resonance was impaired over both sides



Fig. 718—Photograph taken at time of examination

of the chest posteriorly. Breath sounds were poorly transmitted. The systolic blood pressure was 144, and the diastolic 78; the pulse was 96. There was slight difference in the vision in the two eyes: the right eye reading 6/12 and the left 6/10. The pupils were normal as were the fields of vision. The exophthalmometer reading was 26 for the left eye, and 19 for the right. Roentgenographic examination of the left orbit was advised with a view to exploration. Roentgenogram of the orbit revealed nothing abnormal. Roentgenogram of the chest showed milary infiltration of both lungs, probably due to pneumoconiosis. The blood Wassermann test was negative. Examination of the urine and blood revealed nothing abnormal. Exophthalmic goiter was diagnosed.

The patient was admitted to hospital, and iodine as Lugol's solution (10 minims three times a day) was given. The basal metabolic rate was +22, but dropped to +18 six days later. Subtotal thyroidectomy was performed. The left lobe was found to be enlarged to about two and one half times normal.

size and the right lobe to about three times normal. Double resection was carried out and the isthmus removed. About one half of a normal sized lobe was preserved on each side of the trachea. Microscopic examination of the tissue revealed multiple hemorrhagic fibrous cystic degenerating colloid and fetal adenomas in a hypertrophic parenchymatous colloid thyroid with parenchymatous hypertrophy within the adenomas. The resected tissue weighed 56 gm.

Convalescence was satisfactory. Lugol's solution (30 minims a day in three doses) was continued while the patient was in the hospital. On his dismissal from the hospital the dosage was reduced to 10 minims once a day. He was instructed to continue the same dosage of iodine for ten weeks after his return home. Prior to dismissal from the Clinic the exophthalmometer reading for the left eye was 24 and for the right 17.

### COMMENT

Brief records of two patients are presented to illustrate unilateral exophthalmos as a symptom of Graves' disease which, though not infrequent is seldom mentioned in the literature. The presence of such a symptom is sufficient to warrant close observation and careful examination which may be best conducted by an ophthalmologist, if there is doubt as to its cause. The improvement however following the treatment of the constitutional disease may be so great as to allow no doubt of the cause of the unilateral exophthalmos. It may be confused with any condition causing proptosis of one eye the greatest difficulty arising in distinguishing between this condition and orbital tumor either associated with exophthalmic goiter or alone. Koenig reporting a case of unilateral exophthalmos in a case of Graves' disease in 1911 stated that he had found but fifteen cases reported in the literature. Bergin, in 1909, found but three cases of unilateral exophthalmos resulting from Graves' disease in 300 cases of unilateral proptosis resulting from various causes. He stated that three cases had "come under the author's care in which other symptoms of the disease were not marked but in which the subsequent course of events proved the correctness of the diagnosis." Bram, in 1922, in a study of 400 cases of exophthalmos in Graves' disease reported thirty one cases of unilateral exophthalmos, an incidence of 7.7 per cent. Attention was also called in this study to the greater frequency of this eye sign in women.

Exophthalmos is not a constant symptom in Graves' disease. It may occur as one of the earliest symptoms, but, as a rule, it is considered as one of the late manifestations of exophthalmic goiter. Therefore, the incidence of exophthalmos would be expected to vary considerably in any two series of cases, depending on the average duration of the disease in each. In a series of 1020 cases of exophthalmic goiter in the Mayo Clinic, bilateral exophthalmos was definite in 529, an incidence of 51.9 per cent. In another group of 1907 cases of exophthalmic goiter, unilateral

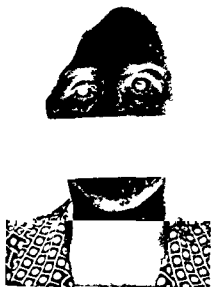


Fig. 719—Photograph taken at time of examination

exophthalmos was found in thirty-nine, in six, however, it was questionable and these cases were not included in determining the incidence, which was 1.06 per cent. Twenty-three of the patients were women and ten were men, which is about the normal ratio of the sex incidence of the disease. The average age of onset of symptoms for this series was thirty-seven and seven tenths years. The average length of the history of Graves' disease was twenty-three months. Two of the cases of this group have just been described. The unilateral exophthalmos in two others is illustrated (Figs. 719, 720).

The cause of the proptosis of the eyeball in exophthalmic goiter is probably not known. Today there is not any evidence of a general agreement among investigators. There are staunch adherents of several theories. A brief of the theory that proptosis of the eyeball in exophthalmic goiter is due to an increase in the fat of the orbit, probably with associated edema, is given by Moore in his text book "Medical Ophthalmology" and in his various articles, references to which may be found in his book. In briefly summarizing he calls attention to two necropsies of



Fig 720 --Photograph taken at time of examination

his own which revealed no other abnormality than an increase in the fat content of the orbit and to an operation performed for marked exophthalmos at which he found an excess of fat in the orbit as well as edema of the fat and of the muscles. An increase in the fat content of the orbit has been described by other observers. Ball refers to it as an established fact. However, case reports by Goodhart and others show failure to note an increase in the fat content. Moore in referring to these, states as an explanation. It is difficult to identify what is an excess of fat in a cavity which is normally full of fat.

The second theory, and equally acceptable is that the protrusion is due to the action of an unstriated muscle within the orbit, namely, Muller's muscle and the fibers described by Landstrom. The theory is that stimulation of the sympathetic, in the hyperthyroidism of Graves' disease produces a hypertonus in these muscles which results in proptosis of the eyeball. In this manner MacCallum and Cornell in 1904 were able to produce exophthalmos experimentally in a dog whose head had been severed completely from the body. However, Muller's muscle is much better developed in the dog according to MacCallum than in man. In another case MacCallum was able to observe the action of the muscle by resecting part of the orbit. Landstrom in 1907, described smooth muscle fibers of the orbit, in addition to Muller's muscle which he believed capable of causing exophthalmos. They also had a sympathetic innervation. This theory would explain satisfactorily the sudden appearance and recession of exophthalmos. However it would seem that the removal of the superior and middle cervical ganglia in cases of exophthalmos should be followed by abatement of the condition. This has not proved uniformly true. C. H. Mayo, in 1914 speaking with regard to the results of sympathetic neurectomy, stated "In some cases in which the sympathetic does not seem to occur as a ganglion but in which fewer and longer communicating branches are found the result has not been so good some patients receiving slight benefit from the operation, the operation seemingly being incomplete. MacCallum and Cornell quote Jonneson as having produced exophthalmos in a human being by the use of a strong current to stimulate the cervical sympathetic while a similar experiment on their part in two instances failed to produce anything but dilatation of the pupil.

It is worthy of note that the right lobe of the gland in Case II was the larger so that it seems illogical to attribute the exophthalmos to pressure on the sympathetic.

Another theory of exophthalmos that it is due to increased vascularity whether from active vasodilation or vasomotor paralysis is discussed by MacCallum and Cornell who succeeded



in producing edema of the face and exophthalmos in a dog by ligation of the internal jugular vein. However additional protrusion was caused by stimulation of the cervical sympathetic. It is well recognized that proptosis is always present in cases of thrombosis of the cavernous sinus. However it is improbable that obstruction to circulation plays any part in the exophthalmos in exophthalmic goiter. There is probably an increase in the vascularity and edema of the tissues of the orbit in all instances.

Benedict has enucleated the eyeball in four cases of exophthalmic goiter for extreme proptosis with ulceration of the cornea. In each case the orbit was explored and tissue was removed for microscopic examination. In no instance did he find excessive fat but in each case there was such extreme waterlogging of all tissues of the orbit (fat and muscles) that Benedict is convinced that edema alone is the most important factor in pushing forward the eyeball.

Cooper in 1849 advanced the theory that exophthalmos is due to relaxation of the muscles of the eye. Other observers have favored the same theory of the cause of proptosis but have assigned various causes for the relaxation. Other derangements such as spastic conditions of the ocular muscles have been thought to cause exophthalmos.

Recently Tilly suggested that the exophthalmos was due to weakness of the eyelids and advised increasing the resistance of the lid by applying collodion dressings. In cases of marked protrusion of the eyeball it has been suggested that the lids be sutured together in order to check further protrusion and to prevent ulceration. However in practice this procedure has never proved beneficial.

As the cause of exophthalmos in Graves disease is in doubt and is explained on the basis of many opinions and theories little information can be given as to the reason why in some instances of a constitutional disease only one eye should be affected. The only positive fact that we can be fairly certain about is that unilateral proptosis is not infrequently a manifestation of Graves disease and that the size and shape of the thyroid gland have no causal relationship.

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## OSTEOMA OF THE SPHENOID BONE PRODUCING UNILATERAL EXOPHTHALMOS

WILLIAM L. BENEDICT

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OSTEOMA of the sphenoid extending into the orbit causes symptoms early, probably before the roentgenogram could be of value. However, it is clear that in a case of unilateral proptosis and loss of vision roentgenograms of the sphenoid should be taken early and preserved for comparison with others taken at intervals. Growth progresses gradually and the onset of symptoms is usually indefinite. Transient swelling of the lids and proptosis is often mentioned as having been observed many years before proptosis became constant, they must be considered the earliest signs of the disease. Loss of vision is the only other symptom noted. Three cases of unilateral proptosis from osteoma of the sphenoid bone are reported.

Case I.—A woman aged thirty nine, came to the Clinic in June, 1924. From 1913 to 1918 there had been proptosis of the left eye lasting from one to three hours and disappearing for several days. Five years later the left eye became more prominent than the right and this condition progressed gradually. About this time she began to suffer from headache mostly on the left side. The headaches became fewer and less severe as the vision of the left eye began to fail in 1922. Glasses did not improve the vision which failed rapidly in the early part of 1924. Under the impression that the proptosis was caused by disease of the paranasal sinuses the left middle turbinate had been removed and the left antrum explored.

At examination the exophthalmometer readings were right 17, left 25. The rotations of the eyes were good except for limited convergence rotation of the left eye. Vision of the right eye was 6/5, of the left 6/20. Ophthalmoscopic examination was negative. A mass could not be detected about the orbit by palpation, although the eye could not be pushed back into the orbit. A roentgenogram of the head showed a dense tumor of the left orbit and marked thickening of the sphenoid bone (fig. 721). July, 1925, thirteen months after the first examination, the proptosis had remained stationary at 7 mm. but vision of the left eye was reduced to 6/30 and there was limitation of the lateral movements of the eye. The fundus was unchanged.

February 1926 vision in the left eye was reduced to 4/60 but remained at 6/5 in the right. There was barely noticeable pallor with veiling of the margin of the left disc at the lower temporal quadrant. There was concentric contraction of the left visual field and absolute central scotoma continuous with the blind spot. The proptosis had increased greatly the exophthalmometer reading was right 18 left 29.

At the last observation May 25 1927 proptosis of the left eye was 12 mm vision in the right eye was 6/5 in the left 2/60 eccentric. The visual field was contracted in the superior and lateral quadrants. The fundus was



Fig. 721.—Thickening of the ala of the sphenoid bone in Case I

negative except for slight pallor of the left disc. A complete physical examination was made at the time of each ophthalmic examination. There was no clinical evidence of syphilis and the Wassermann test was repeatedly negative. Rhinoscopic examination showed only the absence of the middle turbinate and broken down ethmoid walls; there was no pus. From a neurologic point of view it is of interest that during the eighteen months prior to her visit in 1926 the patient had four spells of amnesia or unconsciousness lasting for several days. Successive roentgenograms of the head showed increasing density of the left greater wing of the sphenoid and a dense shadow over the left orbit interpreted as osteoma of the sphenoid. Surgical intervention was not advised.

**Case II**—A woman came to the Clinic in May, 1927. In 1909, after the birth of her thirteenth child, she noticed that she could not see well. Vision gradually failed more rapidly in the right eye than in the left. Six years later the right eye began to protrude and there was swelling of the lids which persisted as bagginess, particularly of the lower lid. Although exophthalmos of the right eye had progressed for eighteen years, a degree of vision had persisted in it until the last three years. An operation had been performed on the nose without any effect on vision. There was no pain in the eyes or head as-



Fig 722—Increased density of the ala of the sphenoid bone and thinning of the frontal bone and pressure changes throughout the bones of the calvarium

sociated with the development of proptosis. However, of late years the bagginess of the lids prevented good coverage of the cornea with resulting epiphora and local pain.

At examination there was proptosis of the right eye of 11 mm. Only the usual external changes due to the extreme exophthalmos and bagginess of the lids were evident. Examination of the fundus of the right eye showed chronic passive edema of the retina, and optic atrophy. There were no hemorrhages, exudates, or significant choroidal lesions. The fundus of the left eye was normal. In the stereoroentgenogram of the head a tumor could be seen almost filling the right orbit, there was breaking down of the outer frontal table and erosion (Fig 722). A lateral view showed thickening of the body and the

greater wings of the sphenoid. Neurologic examination failed to reveal any signs of intracranial extension. There was a palpable mass in the upper nasal quadrant of the orbit.

To relieve the patient's distress the eye as well as a large part of the contents of the orbit was removed. The soft retrobulbar tissue examined by the pathologist was found to be inflammatory. After the soft tissue was removed it was possible to reach the superior and external walls of the orbit. The posterior half of the orbit was filled with hypertrophied bone which could not be loosened by prying with a chisel.

**Case III**—A woman aged sixty, came to the Clinic in June 1927, with osteoma of the sphenoid and squamous cell epithelioma of the orbit. Fifteen years before she had noticed bulging of the left eye which had persisted and



Fig 723—Increased density of the ala o  
indication of a large epithelio

progressed steadily. Proptosis developed w  
had there been any inflammation of the ey  
that the patient was not sure how long the le  
that it had been several years. The vision i  
rection. There was bulging of the tissues of  
larly the lower, were edematous and baggy  
the globe was seen surrounded by dense tiss  
resembling a mass of small vessels. Many tor  
mass seemed to fill the orbit completely.

A roentgenogram of the head showed a de  
ala of the sphenoid on the left (Fig 723). The

aminations were negative. Removal of the orbital tumor was advised. The incision was made through the superior periorbita medially and a large, fibrous lobulated tumor was found extending from the apex of the orbit to above the globe. The tumor was bound down by Tenon's capsule and it was necessary to remove it in pieces to avoid sacrificing the globe. The globe was left in place although the optic nerve was cut. The tumor appeared to be vascular but the pathologic report was squamous-cell epithelioma. Roentgen ray treatment was instituted and continued with satisfactory results for three months after operation. The osteoma was not disturbed.

### DISCUSSION

Osteoma of the sphenoid bone is rare, but needs to be considered as one of the causes of blindness and unilateral proptosis. Insidious in onset, slowly progressive without pain or headache, it seldom causes either local or constitutional disturbances by changes in the pituitary gland, or about the nasal sinuses. The first symptom noted is failing vision. Two of these patients were blind in one eye so that no idea could be gained of the progression of field changes. It may be assumed that the field showed progressive concentric contraction and relative central scotoma, judged from the observations in Case I with regard to the character and position of the tumor.

Osteoma of the sphenoid and endothelioma of the dura occurred in a case reported by Camp<sup>1</sup> from the Clinic in 1924. This association was probably only incidental, as the association of osteoma and epithelioma in Case III, however, it is of great interest clinically. The question of removal of an osteoma of the sphenoid must be considered when the sight of both eyes is endangered.

<sup>1</sup>Camp J. D. Osteoma of the sphenoid bone and dural endothelioma report of a case. *Am Jour Roentgenol*, 1924, xi, 523-524.





PERICARDIAL INFECTION; ACUTE POSTPNEUMONIC EMPYEMA; CHRONIC EMPYEMA; PULMONARY TUBERCULOSIS WITH ABSCESS, ONE-STAGE SURGICAL COLLAPSE; DIAPHRAGMATIC HERNIA

STUART W HARRINGTON

PERICARDIAL INFECTION

Case I —A girl, aged seven was brought to the Clinic July 8, 1925, complaining of headache and pain in the right arm of three days' duration. The temperature was  $102^{\circ}$  on the first day and increased to as high as  $105^{\circ}$  on the afternoon of the third day. Pain also appeared in the calf of the right leg but the pain running down the humerus was continuous and the more severe.



Fig 724 —Case I Purulent pericarditis

At examination the right arm was swollen over the deltoid region and was extremely painful when touched. The cheeks were flushed and the temperature  $104.5^{\circ}$ . Leukocytes numbered 49,600. Urinalysis showed a few blood cells, pus, and granular casts. Staphylococci were present in the blood culture. A roentgenogram of the chest revealed slight enlargement of the

heart. A clinical diagnosis of septicemia with probable osteomyelitis of the right humerus was made.

Exploration showed that the humerus was normal. The child's condition remained about the same. Gentian violet was administered intravenously. July 12 increasing enlargement of the heart was evident both by physical signs and roentgen ray. The pulse gradually became more rapid and rather irregular and there were signs of fluid in the pericardial cavity. July 16 the

the following day when pus was found. Pericardotomy was performed. The cartilage of the fifth rib was removed and an opening made into the lower



Fig. 72b.—Case I. Pericardial wound entirely healed.

portion of the pericardial cavity. A large quantity of pus was drained from the pericardium and a large amount of fibrin was removed from the pericardial wall as well as from the heart itself. There was some immediate improvement in the child's condition following the operation, but the temperature remained high for about three weeks, then gradually came down to normal. The wound continued to drain for a little more than four weeks. The heart shadow

The drainage of the pericardium in this case was instituted by the removal of the fifth costal cartilage which was not at the most dependent portion of the pericardium because it was enormously distended. In this case there was

adequate drainage of the pericardial cavity. No tube was left in the cavity but it was irrigated daily with a physiologic solution of sodium chlorid and later with weak hychlorite solution. In adults, removal of the sixth cartilage would probably give more dependent drainage but in children I think it best to remove the fifth cartilage and enter the pericardium a little higher.

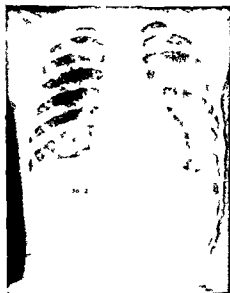


Fig 726—Case I. Normal roentgenologic shadows of lungs and pericardium.

### ACUTE POSTPNEUMONIC EMPYEMA

**Case II**—A boy, aged four, was brought to the Clinic April 1, 1927 with fever and malaise. There was nothing of note in the previous history except scarlet fever in December 1926 following which he had not completely recovered his strength. The initial symptom of the present trouble had appeared six weeks before and was abdominal pain which was relieved by enemas and turpentine stupes. A week later severe dyspnea appeared with signs of pneumonia on the right side. The patient was ill for two weeks then began to improve. Eight days prior to admission the temperature rose reaching  $103^{\circ}$  in the afternoon and there were physical signs of fluid in the right side of the thoracic cavity. Aspiration was performed and part of the fluid was removed.

At examination the child appeared anemic and undernourished. The tonsils were badly infected. There were the usual signs of fluid in the right side of the chest. Urinalysis showed a few blood cells but was otherwise negative. The hemoglobin was 45 per cent, the erythrocytes numbered 2,950,000, the leukocytes 21,400, and the color index was 0.7+. Roentgenologic examination of the chest showed marked increased density of the entire right side with fluid; the heart was displaced to the left (Fig 727). Acute total postpneumonic empyema of the right lung was diagnosed and immediate operation advised.

April 2, 1927 intercostal drainage was instituted by inserting a No. 20 French catheter through a cannula in the posterior axillary line of the seventh



Fig. 727.—Case II. On admission. Right pleural cavity completely filled with fluid displacing the heart to the left.

interspace by the closed method. About 1000 c.c. of thick greenish pus was aspirated from the right side of the thorax. The cavity was irrigated every hour with Dakin's solution by the closed method and at the end of a week the

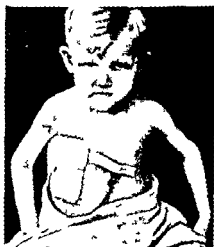


Fig. 728.—Case II. One week after instituting intercostal closed drainage fixation of tube to chest wall. Marked general improvement.

cavity was reduced to 150 c c (Fig 728). The cavity was then irrigated every two hours, and at the end of the third week it measured about 20 cm. The tube was gradually shortened and was removed entirely in the fifth week. The child's general condition improved markedly after the institution of drainage. Twelve days after operation he began to gain weight and at the end of the fourth week had gained about 10 pounds. He is still improving, and has had no relapse since the removal of the tube. The wound is entirely healed six weeks after operation (Fig 729).



Fig 729—Case II. Slight thickening of parietal pleura of lower right chest, otherwise normal. Complete reexpansion of lung.

This case illustrates the advisability of instituting drainage early with the minimal operative procedure if the patient is acutely ill, and also the improvement and the rapid reexpansion of the lung with reduction in the size of the cavity which is obtained by the closed method. The reduction in size of the cavity is most marked in the first week after the institution of drainage. Such patients use blow bottles and other breathing exercises as soon as their condition permits, for inflating the lung and obliterating the cavity, which is sterilized by frequent irrigations with Dakin's solution. In this case nothing more than intercostal closed drainage was necessary after the removal of the tube, as the cavity soon was obliterated by complete reexpansion of the lung, however, if the patient cannot be kept directly under

observation, it is better to perform open operation, with resection of ribs, after the cavity has been reduced to 50 c c or less

### CHRONIC EMPYEMA

**Case III**—A man aged thirty eight came to the Clinic February 14 1927, with chronic empyema of the right lung. The present trouble began March 20 1924 when the patient was confined to bed on account of fever weakness and a dull pain in the right side of the chest. The right thoracic cavity was aspirated and pus was obtained. A thoracotomy with resection of ribs was performed for drainage as there was a large amount of pus in the right pleural cavity. The wound had closed four times and four subsequent operations two rib resections and two thoracotomies had been performed to institute better drainage.

At examination the patient appeared poorly nourished. There was a draining sinus in the right lower part of the thorax. The physical signs sug-



Fig 730—Case III. On admission. Chronic empyema of right lung with marked pleural thickening and almost complete retraction of lung. Compensatory scoliosis of head. mediastinal structures displaced to the left.

gested a large empyema cavity in the right side of the thorax with partial collapse of the right lung. Roentgenologic examination of the chest showed dense pleuritic thickening with marked retraction of the right lung probably resulting from an old empyema cavity. There was marked scoliosis of the dorsal spine (Fig 730). Chronic empyema of the right lung probably post-pneumonic was diagnosed and operation was advised.

The patient was sent to the hospital. A catheter was inserted in the old sinus tract through which irrigation was done every three hours during the day for two weeks prior to operation. During this time a large quantity of

septic material was removed from the empyema cavity and the patient's general condition improved markedly. Because the lung had collapsed almost completely, it was necessary to perform practically complete extrapleural thoracoplasty, this was performed in three stages starting at the apex of the lung and gradually collapsing the chest wall. At the first stage the first six ribs were resected posteriorly; at the second, the seventh to the eleventh ribs inclusive, were resected posteriorly; and at the third, the anterior segments of the second to the ninth ribs inclusive, were removed (Fig 731). There was an interval of ten days between each stage. The tube in the sinus tract



Fig 731—Case 111. Catheter inserted into original sinus tract in right lower thorax and recent wound of first and second stage extrapleural resection of ribs: removal of posterior segments from the first to the tenth rib inclusive.

was not disturbed at any of these operations and irrigation of the cavity was continued daily as before operation. After the third stage the tube was gradually shortened as the cavity had been reduced from approximately 900 c.c. to about 50 c.c. in the six weeks; then the tube was removed and the sinus tract allowed to close (Fig 732).

Convalescence was uneventful and the patient was dismissed May 4, 1927. His general condition was good and the empyema pocket had been completely obliterated. He was informed that pus might possibly reform in the sinus tract. He returned August 10, 1927. Examination and roentgenograms showed that the cavity had completely healed (Fig 733). The patient is well, he has gained weight and has been doing light work.





Fig 732—Case III At dismissal Wound of the three stage extra pleural resection of ribs and the original sinus in the posterior axillary line completely healed Patient entirely free from symptoms



Fig 733—Case III Three months after operation Complete extrapleural resection of ribs with obliteration of pleural cavity

This case shows what can be accomplished by removing the bony framework and allowing the chest wall to collapse where there is a cavity produced by empyema with total collapse of the lung. This is unlike the procedure in acute cases in which it is possible to obliterate the cavity by reinflation of the lung. In chronic cases, reinflation of the lung is impossible because of the marked thickening of the pleura and retraction of the lung, preventing expansion. In cases in which it is possible to obliterate the cavity by bringing the chest wall down to approximate the visceral and parietal pleura, provided the cavity can be sterilized during this procedure, complete healing may be obtained without an open operation. However, there is a possibility of the reformation of pus in the sinus tract, and if it does occur, open operation should be performed. In those cases in which there is a small sinus, slow to heal, and a very small cavity, it is probably best to perform an open operation which is much less extensive than the procedure required to obliterate the original cavity.

#### PULMONARY TUBERCULOSIS WITH ABSCESS; ONE-STAGE SURGICAL COLLAPSE

**Case IV.**—A woman, aged thirty-two, was admitted to the Clinic June 8, 1927, complaining of cough and fever. She was well until 1918. Pleurisy developed in the right pleural cavity and about 600 c.c. of fluid was aspirated. The patient gradually recovered and gained weight and strength. In 1924 she caught cold and slight cough, fever, and general malaise followed. Tuberculosis was diagnosed in 1925, and she had been in a sanatorium until coming to the Clinic. There had been only one hemorrhage but breath of tuberculosis had been repeatedly found in the sputum. There was constant cough and afternoon fever of 100° and 101°. Her voice has become hoarse during the last year, the hoarseness was more or less progressive for about six months and since that time had been stationary.

At examination the larynx was thickened and there was ulceration in the posterior commissure which appeared inactive. The area of ulceration in the anterior commissure was granular and appeared more active. There was extensive active tuberculosis of the right lung with cavitation, but the clinical evidence indicating involvement of the left lung was questionable. A roentgenogram of the chest revealed bilateral pulmonary tuberculosis with a large cavity and almost complete retraction of the upper lobe on the right (Fig. 734). A clinical diagnosis was made of pulmonary tuberculosis with cavities in the right lung, moderate involvement of the left lung, with activity of the tuberculous process doubtful, and tuberculous laryngitis.

This patient was observed in the hospital. After about a week her temperature became normal and surgical collapse of the right lung was advised. June 21, one stage extrapleural thoracoplasty was performed. The first to



Fig. 734—Case IV. On admission. Tuberculosis of the middle upper right lobe with cavity extending from apex to the second rib. Multiple areas of bronchiectasis below the cavity. Thickened pleura of right base with adhesions to diaphragm.



Fig. 735—Case IV. Complete collapse of right lung seven days after one-stage posterior thoracoplasty.

the tenth ribs, inclusive, were resected; 7 cm. of the first rib was removed and the amount increased rib by rib to 15 cm. of the tenth rib.

The patient stood operation very well and convalescence was without incident. At first the temperature was 105.5°, but it gradually decreased on the fourth day and after the sixth there was entire freedom from fever. Satisfactory collapse of the lung was obtained and complete collapse of the



Fig. 736—Case IV. One stage extrapleural thoracoplasty with wound completely healed. The spine is erect with no drooping of the shoulder, good function of the arm on the operated side.

abscessed cavities (Fig. 735). There was primary healing of the wound. On the whole, recovery was satisfactory and the patient was dismissed from observation July 30, 1927 (Fig. 736).

This case demonstrates what can be accomplished in cases of extensive pulmonary tuberculosis with cavitation complicated by such conditions as tuberculous laryngitis. A one-stage operation gives better collapse of the lung and is advisable in cases in which there is a large cavity, if the condition of the patient at the time will permit this procedure. In a recent letter the patient stated that her general condition was markedly improved, she was practically free from fever and cough and had gained weight.

## DIAPHRAGMATIC HERNIA

**Case V**—A woman aged sixty was admitted to the Clinic June 23 1927. Her chief complaint was dysphagia. The dysphagia had appeared about a year before. She had been troubled particularly after eating a heavy meal with distress in the lower part of the thorax as if the food met an obstruction before entering the stomach; this was relieved with difficulty by belching or regurgitation of food and rather easily by lying down. The dysphagia had increased during the year. If the patient ate very slowly and masticated her food thoroughly she had less distress. She had noticed that hiccough at times gave immediate relief and that soda gave some relief. Lately the distress had been more or less constant after each meal and it had been necessary for her not only to restrict her diet but also to reduce the quantity. She had lost about 15 pounds in the last five months. For a number of years



Fig. 737.—Case V. Diaphragmatic hernia. Herniation of the cardiac end of the stomach through the esophageal opening causing hour glass deformity of the stomach.

the patient had noticed pain in the upper right quadrant of the abdomen and

seemed to be no relation to the taking of food or the type of food eaten. There had been no sharp pain and no jaundice. The patient had been treated for gallbladder disease for some time.

The patient was moderately obese, weighing 173 pounds (normally the weight varied from 185 to 190 pounds). Urinalysis and examination of the blood were negative. Roentgenograms of the thorax revealed a shadow on the left side of the body probably in the stomach. A roentgenogram of the stom-

ach revealed cardio-pneum and herniation of the cardiac third of the stomach through the esophageal opening in the diaphragm (Fig 737). Non traumatic diaphragmatic hernia through the esophageal opening was diagnosed and operation was advised.

The patient was sent to the hospital. Gastric lavage was carried out twice a day. She was given forced feedings for three days prior to operation. July 5, 1927, operation was performed. An abdominal approach was made through the left rectus muscle (Fig 738). The skin incision was parallel to

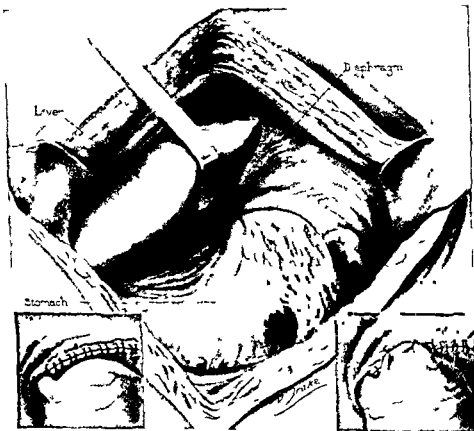


Fig 738—Case V. Abdominal approach through left rectus incision. Herniation of one half of the stomach through the esophageal hiatus. Method of closure of the opening to the left of the esophageal opening and suturing of the stomach to the diaphragm after closure.

the costal margins and the incision in the fascia extended from the inner to the outer margin of the fascia of the rectus muscle. A little more than a third of the cardiac end of the stomach protruded through the diaphragm into the left thoracic cavity and extended posteriorly back of the pericardial sac to the right pleura. The opening consisted of a dilatation of the esophageal opening to the left; the esophagus was of normal length extending to the diaphragm and being attached to the inner margin of the opening. Numerous

adhesions between the stomach and the omentum of the sac were separated. After the gas in the stomach had been evacuated by means of the stomach tube it was easy to reduce the stomach and restore it to the abdomen. The stomach tube was left in place during closure of the hernial opening to prevent encroachment on the passage for the esophagus through the diaphragm. The opening was closed with linen sutures, the first suture taking the inner margins of the esophageal opening, folding in the sac and incorporating a small portion of the tissue of the left wall of the esophagus. The remaining sutures were used to hold the sac, and the opening in the diaphragm was closed by mattress sutures. The fundus of the stomach was secured anterior to the suture line with several interrupted catgut sutures to the diaphragm and the stomach tube was removed. The gallbladder was normal. The abdomen was closed without drainage (Fig. 739).



Fig. 739 —Case V. Diaphragmatic hernia repaired through abdominal approach. Entire stomach below the diaphragm. Gas bubble at cardia and small amount of barium in the esophagus.

Convalescence was uneventful. Fluids were withheld until the fifth day, and during this time the patient was given a solution of sodium chloride subcutaneously and glucose intravenously. On the fifth day she was permitted to take food and was on a soft diet until the tenth day. She was dismissed from the hospital on the fourteenth day.

The symptoms of diaphragmatic hernia are inconstant as they depend to a great extent on the site of the hernial opening and the contents of the hernial sac. Because of the obscure symptoms, gastric or gallbladder disease is diagnosed in many

instances It is often impossible to make a positive diagnosis without roentgenologic examination of the stomach, colon, or thorax, and it has only been since the advent of the roentgen ray that a positive diagnosis of diaphragmatic hernia could be made before operation

In my experience the diaphragmatic hernia most commonly seen in adults is that through the esophageal opening The stomach is practically always involved in these hernias, they sometimes also contain the colon, and the larger ones may include the spleen This type of hernia is probably the result of incomplete obliteration of the infracardiac bursa, which usually occurs in embryos of 17 to 18 mm The contents of the hernia are usually covered by a sac which consists of both diaphragmatic peritoneum and pleura although these serous membranes may be fused The removal of this sac is not essential to the cure of the hernia and when it is folded under it adds to the strength of the closure

The treatment in these cases depends to some extent on the degree of disability of the patient In most instances medical treatment is of little value Surgical treatment consists of replacing the herniated viscera into the abdomen and closing the hernial opening The approach may be through the abdomen, through the thorax, or through both thorax and abdomen, depending to some extent on the situation of the opening and the preference of the surgeon

Regardless of the type of approach the essential feature of the operation is closure of the hernial opening which must be accomplished to give relief from symptoms In smaller hernias closure can be made by approximating or overlapping the margins of the opening In some of the larger hernias in which too much tissue has been lost to permit approximation or overlapping of the margins I have obtained satisfactory results by performing phrenic neurectomy, relaxing the diaphragm and permitting closure of the opening This changes the condition from diaphragmatic hernia to eventration The approximation of the edges of the opening is also of value in cases in which there is incarceration or strangulation of the hollow viscus



In operating for diaphragmatic hernia there are several advantages in the abdominal approach. The operative risk is probably less and there is less danger of postoperative complications because in many instances there is a definite sac separating the abdominal from the pleural cavity and it is not necessary to open the pleural cavity. Of course whether or not there is a sac depends on the type of hernia, and particularly in cases of hernia due to direct trauma there is no sac. The abdominal approach also permits exploration of the abdomen for other lesions which may be a factor in the patient's complaints. There is probably a little more difficulty in closing the opening from the abdominal side but there is less danger of injury to the abdominal viscera because they are in sight and can be easily retracted. The mortality rate with the abdominal approach is not great. In the last three years I have operated on eleven cases in this manner with no mortality.

## CHRONIC SUBDURAL HEMATOMA

WINCHELL MCK CRAIG

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INTRACRANIAL hemorrhages resulting from trauma not only present varying symptoms and methods of onset but they vary in response to treatment. If signs of intracranial pressure occur soon after injury to the head the differential diagnosis is not difficult and the measures employed to combat the result of the injury are commensurate with the severity of the lesion. However there is a group of misleading cases in which the injury to the head has been insignificant and the symptoms develop with insidiousness and a latent period. Such intracranial hemorrhages are called 'chronic subdural hematomas' and closely simulate deep-seated intracranial neoplasms. In a great many instances it is difficult to elicit a history of trauma or it is of little significance and the history is that of increasing intracranial pressure usually developing over a period of from five weeks to ten months. There is little in the physical manifestations to indicate the underlying lesion and the neurologic data differ little from those found in cases of neoplasm. Five illustrative cases are presented. Case I is typical of this type of lesion and illustrates the difficulty of diagnosis, the apparent clinical severity of the lesion and the excellent results obtained from surgical procedures.

### REPORT OF CASES

Case I.—A man aged forty-one was brought to the Clinic in a semi-comatose state and presented the attitude of apathy so characteristic of brain tumor. He had enjoyed excellent health until six months before admission at this time it became apparent to the relatives that he was becoming somewhat silly, extremely forgetful and slightly disoriented. He was drowsy and often fell asleep while attempting to carry on his work as a barber. The symptoms became progressively worse and recently he became completely disoriented. He said that he felt well but often put his hand to his head and

remarked that his head ached. His physician noticed choked disks, made a diagnosis of brain tumor, and referred him to the Clinic.

A history of injury could not be elicited until after the operation and then the patient recalled that while he was playing in a band, he had struck his head a slight blow on the bell of a large horn used by the man sitting at his side. The blow occurred as he arose to play a solo and it did not even delay his progress or playing. The date of this accident preceded the onset of symptoms about a month. He was under observation in a hospital for ten days during which time he slept almost continually. When he could be aroused, he insisted on whispering his answers to questions. He persisted in repeating these answers as well as the movements he was asked to carry out, so that the examination had to be interrupted frequently. At times he presented the picture of catatonic rigidity. There was incontinence of urine and

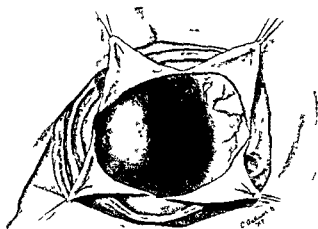


Fig. 740—Appearance of the lesion of chronic subdural hematoma immediately after the dura was incised.

feces. The Wassermann test of the blood was negative; the hemoglobin was 76 per cent; the erythrocytes numbered 4,680,000, the leukocytes 11,100; the differential of lymphocytes was 16 per cent, of large mononuclears 7 per cent, of transitionals 1 per cent, of neutrophils 75 per cent, and of eosinophils 1 per cent. The roentgenographic examinations of the head and chest were negative. The pupils of the eye were dilated and stiff, the media clear. Examination of the fundi showed bilateral choked disks of 3 diopters on the right and of 2 diopters on the left with few hemorrhages. The fields were normal, apparently, the upward gaze was impaired. Neurologic examination elicited mild left facial paralysis, marked rigidity of the left arm, moderate rigidity of the right arm, positive Babinski reflex on both sides and relaxation of the rectal sphincter. A diagnosis was made of brain tumor of the right frontal lobe.

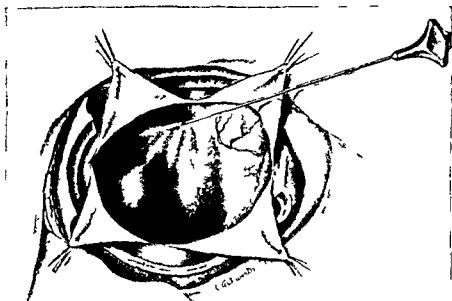


Fig 741 —Appearance following aspiration demonstrating the collapse of the capsule

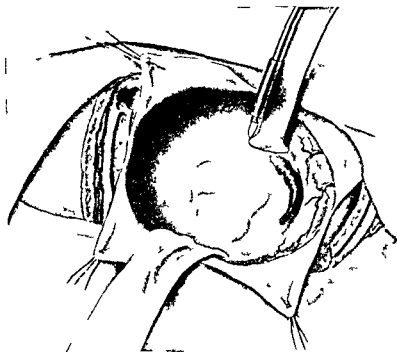


Fig 742 —Depression of the cortex following the stripping of the capsule from the underlying pia arachnoid Small blood clots similar to that in the illustration were found about the edge

The patient's condition was becoming rapidly worse and he was given glucose intravenously on three successive days. He improved slightly but not sufficiently to contraindicate operative interference. Consequently subtemporal decompression on the right side was performed. With exposure of the dura a yellowish brown discoloration was seen and the dura was under increased tension. The dura was incised and a large encapsulated dark reddish brown mass was seen lying directly beneath (Fig 740). There was a definite line of demarcation and the mass fluctuated giving the appearance of subarachnoid hemorrhage. A spinal puncture needle was inserted and about 240 c c of dark brown fluid aspirated and the tumor collapsed (Fig 741). This fluid resembled bile in color and in consistency. The capsule was incised and the cavity irrigated with a physiologic solution of sodium chlorid. Several large clots were removed and it was found that the capsule could be stripped easily from the underlying cortex. This left a depression in which the convolutions and the cortical vessels appeared to be normal (Fig 742). The wound was closed without drainage. The patient regained consciousness immediately, became alert mentally and was completely restored to normal. Three weeks after the operation he returned to his home completely recovered except for comparatively slight general weakness.

**Case II**—An Italian cook, aged thirty, came to the Clinic complaining of headache, blurring of vision and vomiting for about four months. Until after the operation he denied having been injured. He then remembered *having fallen on the ice seven months previously*. He was unconscious for about ten minutes when someone passing aroused him and assisted him to a nearby house. He recovered completely the same day. Three months after this accident severe occipital headaches developed with blurring vision and projectile vomiting three or four times daily. The headaches had lasted until two months before admission when they suddenly disappeared. The blurred vision became more severe and vertigo appeared which caused him to reel at times like a drunken man. Diplopia developed and lasted two or three

Examination of the fundi showed papilledema. Ophthalmoscopic examination was negative except for

revealed. At operation the dura was found to be characteristically discolored and a chronic subdural hematoma was removed. The patient convalesced uneventfully. Examination three weeks after operation showed that the papilledema was receding and his general health improving.

**Case III**—A Norwegian farmer, aged forty six, came to the Clinic complaining of right sided weakness, headache, temporary blurring of vision and vomiting for about half a month. There was also slight mental confusion for several months prior to the onset of the present illness. He fell from the ground and lost consciousness for a few moments. After two or three days in bed he

resumed his work and felt no ill effects. Two weeks after the injury slight weakness in the right leg and knee developed which on many occasions nearly caused him to fall. About two weeks after this frontal headaches would awaken him at about four o'clock in the morning and last for approximately one hour. Non projectile vomiting came on two or three times a week, it was not associated with nausea.

The systolic blood pressure was 118, the diastolic 70, and the pulse rate 72. The cerebrospinal fluid was clear and the cell count showed two lymphocytes to the field. There was a bilateral choked disk of 3 diopters with hemorrhages and exudates. Neurologic examination revealed slight vertical and horizontal nystagmus on the right. The reflexes were somewhat irregular with slight increase of biceps on the right, of the Achilles bilaterally, more on the right, and slight diminution of the patellar reflex bilaterally. There was slight loss of coordination of fingers and toes on both sides. The patient was definitely below normal for intelligence, memory, and cooperation. A diagnosis was made of lesion in the left side of the brain, probably in or near the frontal lobe, but as the site was not definite, ventriculography was advised and carried out under local anesthesia. With the opening of the dura on the left side a dark, vascular mass was encountered which, owing to its similarity to a cellular glioma, was not disturbed and ventriculography was completed. The films showed a mass in the left temporoparietal region pushing the ventricles downward. At operation the dura was found to be discolored and underneath a large chronic subdural hematoma containing about 60 c.c. of brownish fluid was discovered and removed. Colorless cerebrospinal fluid escaped through a cannula inserted into the posterior horn of the ventricle. Convalescence was uneventful. When the patient was examined eight months after the operation he was well.

**Case IV**—A boy, aged fourteen, who was athletic had recently competed in several wrestling matches. One month previously he had experienced severe headache centering about the vertex. The headache had become gradually more severe and signs of increased intracranial pressure developed slowly. When he was first seen at the Clinic he was having paroxysmal headaches coming on at intervals of from one to two minutes; this made examinations extremely difficult.

The chief symptoms elicited on examination were adiadochokinesia of the left forearm, incoordination of the left lower extremity, positive Babinski on the left side, positive Kernig, and nystagmus on rotation of the eyes in all directions. Examination of the eye revealed bilateral choked disks of from 1 to 2 diopters with hemorrhages and exudates but no field changes. On spinal puncture the cerebrospinal fluid was clear and under pressure of 25 cm. Following spinal puncture the patient experienced some relief from the headaches, but later they returned with increased intensity, the pulse became slow and irregular, and he died on the morning after admission.

Postmortem examination disclosed a large chronic subdural hematoma in the right parietal region. The dura was characteristically discolored and the hematoma contained thick, dark fluid simulating bile.

**Case V.**—A man, aged twenty one, had been employed as a practical nurse in a hospital for the insane. He gave a history of having been thrown over the head of an insane patient, four months previously, alighting on his back and occiput. He was unconscious for half an hour, after which he felt perfectly well and returned to his work the same day. He had been perfectly well until about a month before admission to the Clinic when he suddenly became dizzy, and within a few days, blurring of vision, nausea, vomiting, and occipital headaches developed over the entire right side of the head. The headaches were intermittent and lasted from an hour to half a day. He was unable to work and, four days before admission, the symptoms became more severe and diplopia, transient spells of opisthotonos with residual paralysis of the left leg developed. Apparently, there were no sensory disturbances, but there was severe pain in the cervical region. On account of the severity of symptoms and signs of intracranial pressure the attending physician made a spinal puncture. About 15 c c of clear cerebrospinal fluid had been removed when suddenly, while the needle was still in place, the patient screamed and assumed an extreme opisthotonos position. He was in this position and suffering extreme pain in the back and neck with frequent spasmodic contractions when he was brought to the Clinic.

Examination was extremely difficult but bilateral choked disks of from 3 to 4 diopters with hemorrhages and exudates were noted. The extreme opisthotonos position prevented detailed neurologic examination although it was found that the Achilles reflex were bilaterally increased and that there was no Babinski reflex. A tentative diagnosis was made of lesion of the posterior fossa with herniation through the foramen magnum of the cerebellum and medulla. The patient's position prevented operative interference and hypertonic sodium chlorid solution was given intravenously and magnesium sulphate by mouth. He relaxed immediately and the pain was relieved for about five hours. He then suddenly returned to the opisthotonos position, and the pain became excruciating. Relief was obtained by intravenous treatment, and the patient was taken to the operating room for ventricular puncture. He died suddenly from medullary pressure.

At postmortem examination, a large chronic subdural hematoma was found over the right temporoparietal region with internal hydrocephalus and herniation of the medulla into the foramen magnum. The dura over the lesion was characteristically discolored and the hematoma could be stripped easily from the underlying cortex.

### COMMENT

All five cases demonstrate the difficulty of a differential diagnosis of chronic subdural hematoma and intracranial neoplasm; they also demonstrate a common characteristic, namely, the severity of the clinical manifestations. However, Cases I, IV, and V were discouraging from the beginning, and consequently, Case I stands out as a spectacular example of the results of opera-

tion in such cases. Cases II and III demonstrate also the satisfactory results of surgical treatment.

### CONCLUSIONS

1. The foregoing cases emphasize certain points to be considered in the differential diagnosis of increased intracranial pressure. Chronic subdural hematomas occur more commonly than has been believed. They develop subsequent to trauma so insignificant that it is often forgotten by the patient or overlooked in the anamnesis. The condition should be considered in all cases of mild trauma followed by a latent period after which signs of intracranial pressure develop insidiously.

2. Lumbar puncture may be of assistance in determining the diagnosis if xanthochromic fluid is present; however, in the cases in this series in which the procedure was carried out, the cerebrospinal fluid was clear. Case V demonstrates one of the pitfalls of lumbar puncture in the face of increased intracranial pressure.

3. Ventriculography may assist in locating the lesion and exploratory craniodural puncture over the suspected area should be done; if this verifies the diagnosis, the removal of the more or less organized clot, either through an enlarged trephine opening or an osteoplastic flap, is the procedure indicated. If complications arise subsequent to operation, they are due, probably, to edema, rather than to a reformation of the hematoma, and should be treated by hypertonic solution intravenously. However, the postoperative course is usually spectacular and uneventful, and the patient recovers completely in a short time.





## LIPOMA OF THE PHARYNX

FRED A. FIGI AND VERNE C. HUNT

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BENIGN tumors of the pharynx, large enough to be of clinical significance, are not frequently encountered. Lipoma is one of the rarest of this group. Few of the modern textbooks on diseases of the throat even mention it. Laryngeal lipoma, on the other hand, is mentioned in practically all textbooks. However, the rarity of pharyngeal lipoma has been greatly exaggerated. Kenyon, reporting a case of this type in 1911, said "So extremely rare are lipomas in this region that I finally abandoned searching the literature and accepted the statement in the 1909 edition of Dr. D. Braden Kyle's 'Diseases of the Nose and Throat,' that but one pharyngeal lipoma had at that time ever been reported." As a matter of fact, about twenty such case-reports had appeared in the literature prior to that date. The most complete review of tumors of this type that we have been able to find is that of Herriman, who, a little more than a year ago, published a report of twenty five cases noted in the literature, and added one case of his own. In 1922, Vinson reported a case from the Mayo Clinic, of pedunculated lipoma of the esophagus, attached just below the introitus. The case reported herewith, that of a large retropharyngeal lipoma, is the only true lipoma of the pharynx observed in the Mayo Clinic.

### REPORT OF CASE

A taxi driver, aged fifty years, came for examination February 23, 1927. Two years previously he had consulted his physician because of a sense of fullness in the throat. Examination at that time revealed a swelling over the posterior wall of the throat which was thought to be due to a cyst. The throat was painted with silver nitrate solution and a gargle prescribed. A year later, a year prior to examination at the Clinic, the sense of fullness in the throat had become more marked, dyspnea, and dysphagia had developed, and an attempt was made to aspirate the tumor, this was not successful. Since then

all symptoms had increased in severity progressively. Dyspnea at night was extreme and accompanied by noisy stridor. Alarming choking spells occurred frequently during the night. However, the patient stated that he had had no pain whatever. He was a powerful, muscular man, weighing a little more than 200 pounds and spoke with a deep hollow guttural voice which instantly betrayed the presence of a mass in the throat.

Examination of the pharynx revealed a large, rather firm, smooth, non-ulcerated tumor about 5 by 9 cm., bulging the entire posterior wall forward from just below the vault of the nasopharynx almost to the level of the base of the epiglottis (Fig. 743). The tumor was crowding the soft palate forward

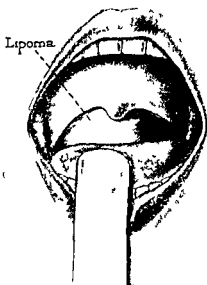


Fig. 743 —Lipoma bulging the posterior wall of the pharynx

and had completely blocked off the nasopharynx from the oropharynx. There was no evidence of inflammatory reaction and fluctuation could not be elicited. The general physical examination was negative except for a moderate degree of cardiac hypertrophy and emphysema of the chest. The urinalysis, blood count, Wassermann test on the blood, and roentgenogram of the chest were negative. The history and symptoms were identical with those frequently encountered in cases of mixed tumor of the pharynx, and a diagnosis of probable mixed tumor was made.

The large size of the tumor made swallowing difficult and embarrassed respiration to such a degree that preliminary tracheotomy was necessary. One week later the tumor was removed through the external lateral approach. A longitudinal incision (Fig. 744) in the right side of the neck just anterior and

parallel to the sternocleidomastoid was carried down to the carotid sheath which was exposed for a distance of about 10 cm to the point where the anterior belly of the omohyoid muscle passes underneath the sternocleidomastoid

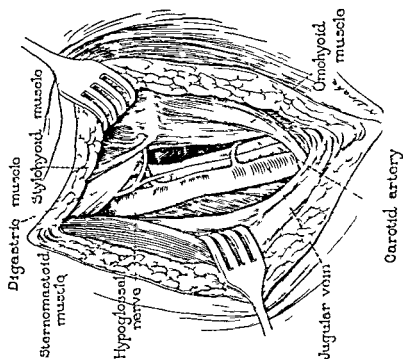


Fig 715—Exposure of the carotid sheath



Fig 714—External approach to tumor of pharynx. In cision along the upper two thirds of anterior border of the sternocleidomastoid muscle

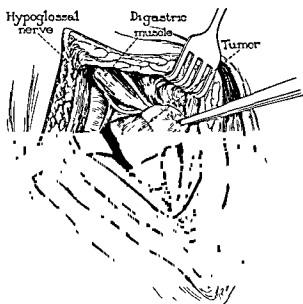


Fig. 746 —Retraction of carotid sheath backward affording access to the tumor after deep incision in cervical fascia



Fig. 747.—Lipoma, 7 by 6 by 2.5 cm.

(Fig 745) Retraction of the carotid sheath backward (Fig 746) exposed the deep cervical fascia which was incised bringing into view the retropharyngeal tumor which was definitely encapsulated and readily enucleated. The tumor which proved to be a true lipoma measured 7 by 6 by 2.5 cm (Fig 747). The incision was closed without drainage and after a few days the tracheotomy tube was removed. Convalescence was uneventful with subsequent restoration to normal of the contour of the oropharynx.

The marked discrepancy in the number of cases of lipoma reported by different authors is due chiefly to difference in classification. Tumors attached low in the hypopharynx including the pyriform fossa, and partially within the larynx have been classified as laryngeal lipomas by most authors as a matter of fact in a few instances of so called lipoma of the larynx the attachment of the tumor was entirely outside the larynx. Others have grouped the retropharyngeal lipomas as well as those bulging into the pharynx from the lateral walls with the deep cervical lipomas. It would appear that both these groups might well be considered pharyngeal since the tumors occupied chiefly the lumen of the pharynx and were chiefly attached to the pharyngeal wall.

Lipoma of the pharynx may occur at any period of life from early childhood to old age. Of the twenty eight cases reported in which the age and sex of the patient was mentioned the youngest was a child aged four years and the oldest was a woman aged more than ninety. Seventeen were males and eleven were females.

In the reported cases a few fibrolipomas and one lipomyxofibroma are included. The tumors may be pedunculated with a pedicle of varying thickness and length or they may have a broad sessile attachment and merely bulge into the lumen of the pharynx. They are usually single but may be multiple as was true in the case reported by Hannecart in which a mass of lipomas almost "as large as a child's head" reached from the level of the inferior maxilla to the clavicle. They present as a rule, a smooth surface, but may be deeply lobulated as in the case reported by Hohlbeck. In size they vary from 1.5 to 10 cm in diameter. In Holt's case the tumor was pedunculated and measured 22.5 cm in length.

Most of the tumors arising from the posterior wall of the pharynx were sessile, while those arising from the tonsillar fossæ or pillars, the base of the tongue, or about the pyriform sinuses, were pedunculated

Woods calls attention to an interesting excavation or hollowing out of the anterior surface of the bodies of the cervical spine underlying the retropharyngeal tumor in his case. He presents roentgenograms which show this defect. Such a concavity is

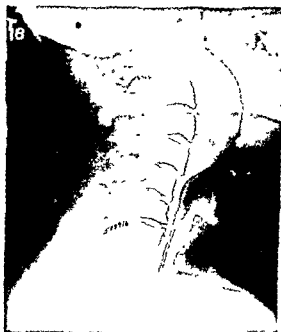


Fig 748 —Outline of lipoma of the pharynx

frequently seen in the hard palate following removal of slow-growing, soft-tissue tumors from the roof of the mouth, and is apparently due to pressure absorption. This concavity of the vertebral bodies was not evident in our case, but the tumor stood out distinctly in the lateral view of the cervical spine (Fig. 748).

The symptoms of lipoma of the pharynx are those of any slow-growing neoplasm in this region, and vary with the size, situa-

tion and type of attachment of the tumor. A tumor with a sessile base may bulge into the pharynx markedly without producing symptoms, especially if it has grown slowly. The symptoms usually produced by a growth of this type are a sense of fullness in the throat, difficulty in getting the bolus of food started in the act of swallowing, and dyspnea. Difficulty in breathing is always increased while the patient is relaxed during sleep when it is accompanied by noisy stridor, and at times, by severe smothering spells. As a rule, annoying symptoms are produced much earlier by pedunculated, than by sessile pharyngeal tumors. This is especially true if the pedicle is of sufficient length to permit the tumor to drop into the larynx or into the introitus of the esophagus. There will then be difficulty in swallowing, repeated vomiting, disturbances of phonation or sudden alarming choking spells. The tumor may be coughed or vomited into the mouth or even outside of it. Sudden death from asphyxiation occurred in the cases reported by Holt and Shattock.

The diagnosis of pedunculated lipoma of the pharynx should present little difficulty, as the history and clinical data are characteristic. The differentiation of sessile lipomas, however, offers an interesting problem on account of the variety of similar appearing tumors which occur in the throat. Carcinomas of the mixed tumor type, that are frequently seen in the pharynx, bear a striking resemblance. The clinical history and the consistency of these tumors on palpation may be precisely the same. The long duration of a fatty tumor usually distinguishes it from an inflammatory mass or a malignant lymphoma. Fibromas and chondromas occasionally arise from the transverse processes of the cervical vertebrae and the intervertebral cartilages, and may simulate a pharyngeal lipoma. Retropharyngeal abscesses, infected bursæ, pharyngeal cysts and sarcomas of various types may be difficult to differentiate on clinical examination. Unrecognized aneurysms bulging the posterior and lateral walls of the pharynx have been incised for biopsy and may simulate lipoma. Lingual thyroids unless cystic degeneration is present, should offer no difficulty as their appearance is characteristic.

The treatment of these tumors like that of any other type



TABLE I  
CASES OF LIPOMA OF THE PHARYNX

No	Author	Date	Age	Sex	Site	Size	Treatment	Result
1	Foucher	1849	39	M	Anterior wall hypopharynx	1 inch in diameter	Removal through mouth	Recovery
2	Holt	1854	80	M	Anterior wall pharynx aryepiglottic fold epiglottis	9 inches long	None	Sudden death
3	Oliver	1870	28	M	Soft palate	Walnut	Removal through mouth	Recovery
4	Wagner	1872	13	F	Dorsum tongue epiglottis	Hen's egg	None	Death from smallpox
5	Taylor	1877	4	F	Postpharyngeal wall	3 by 3.5 inches	Tracheotomy	Recovery
6	Roe	1879	7	F	Postpharyngeal wall	Large hen's egg	Removal through mouth	Recovery
7	Richet (T de Ott)	1880	82	M	Soft palate		Removal through mouth	Recovery
8	M Bride	1889	71	M	Outer part right pyriform sinus	Banana's egg	Removal through mouth	Recovery
9	Bach, J A	1891	52	M	Pharynx and nasopharynx	1.75 by 4 inches	Removal through mouth	Clean enucleation
10	Hohlbeck	1891	61	M	Base of tongue	Multiple tumors pen to hen's egg	Tracheotomy cheek split removal through mouth	Recovery
11	Tobald	1892	64	M	Pharynx level of arytenoid	Walnut	Tracheotomy	Death
12	Onoda	1895	*	*	Left tonsil	0.5 by 1 cm	Removal with snare	Recovery
13	Farlow	1895	63	M	Low in pharynx	Extended 0.5 inch beyond lips	Removal through mouth	No recurrence after three months
14	Haug	1896	90+	F	Right tonsil	Hazel nut	Removal through mouth	No recurrence
15	Bond	1898	49	F	Soft palate	Large extending from behind right angle of jaw to left of midline	Removal through mouth	No recurrence
16	Ripault	1898			Soft palate	Filled the mouth	Removal through mouth	Recovery
17	Avella	1898	20	M	Tonsil	Hazel nut		

		1899	28	M	Right base of tongue and pharynx	Cover 1 two-thirds base of tongue	Removal, snare, an 1 cautery	No recurrence
18	Ingalls							
19	Onodi†	1899	12	F	Right tonsil	1 by 1.5 cm	Removal with snare	Recovery
20	Harnett	1900	35	M	Anterior lateral pharyngeal wall	Child's head	Removal through external incision	Recovery
21	Cheval	1902	33	F	Pharynx	Right pharynx bulged almost to left tonsil	Tracheotomy removal through mouth	No recurrence
22	Milligan	1902	37	F	Postpharyngeal	Extended from level of soft palate to below larynx	Removal through external incision	Recovery
23	Finler	1904	41	F	Posterior to right tonsil	End of little finger	Removal through mouth	
24	Gautier	1909	42	M	Right soft palate	7 by 9 cm	Removal through nose with snare	
25	Keller	1909			Fossa of Rosenmüller	Walnut	Removal through mouth	Clean enucleation
26	Shattock	1909	76	M	Base of tongue epiglottis	1.5 inches diameter	None	Sudden death
27	Kenyon	1911	27	F	Posterior and right lateral wall of pharynx	2.25 by 3.25 inches	Removal through mouth	No recurrence
28	Fraser	1916	76	M	Left wall of hypopharynx, ary epiglottic fold	2.5 cm diameter	Removal under suspension	Recurrence (?)
29	Tilley	1919	15	F	Left palate and pharynx	1.2 by 2.5 inches	Laryngotomy enucleation	Recovery
30	Tumbl	1923			Parapharyngeal tissues bulking into pharynx	5 by 6 by 9 cm	Tracheotomy removal, external incision	Not stated
31	Jefferson				Retropharyngeal	6 inches long	Removed, external incision	Not stated
32	Bourgeois and Souille				Left tonsillar fossa	1 little finger	Excision with cautery	Not stated
33	Herriman	1926	68	M	Posterior and right lateral pharyngeal wall	Walnut	Enucleation through mouth	No recurrence
34	Woods	1926	41	M	Retropharyngeal	Larger than man's fist	Laryngotomy removal external incision	Recovery
35	Mayo Clinic	1927	50	M	Just below vault of nasal pharynx	7 by 6 by 2.5 cm	Enucleation	Recovery

\* Young child

† Second case

of slow growing encapsulated tumor of the pharynx is surgical. Removal is most satisfactorily accomplished through the mouth when the size and position of the growth will permit. Most of the pedunculated lipomas were readily removed with either the cold or cautery snare. In Fraser's case the tumor in the lower part of the hypopharynx was removed under suspension laryngoscopy. Kellner removed a fibrolipoma 'the size of a walnut' from the nasopharynx through the nose. In Hohlbeck's case removal through the mouth was accomplished after splitting back the cheek and preliminary tracheotomy. The tumors with a broad base cannot be grasped by a snare and must be enucleated. This was possible through the mouth in a number of instances. In Tilley's case the tumor was enucleated in this manner after preliminary laryngotomy which became necessary as ether anesthesia was induced. When the sessile mass is either so large or situated so low in the hypopharynx that it cannot be taken out through the mouth removal through an external incision becomes necessary. An incision along the anterior border of the sternocleidomastoid usually gives the most satisfactory exposure. General anesthesia is almost invariably required and preliminary tracheotomy is as a rule advisable even if the patient is having little respiratory difficulty. Frequently as the patient loses consciousness marked respiratory obstruction develops due to relaxation of the pharyngeal muscles.

The prognosis following clean enucleation of a lipoma of the pharynx is good. Recurrence not infrequently develops following removal of pedunculated tumors with the snare but thorough cauterization of the base of the pedicle with the actual cautery or diathermy should lessen this possibility.

## FURTHER STUDIES ON THE EMPTYING OF THE GALLBLADDER

GEORGE M HIGGINS AND FRANK C MANN

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IN "Surgical Clinics of North America," October 1926, we reported certain of our conclusions concerning the emptying of the gallbladder in some of the lower vertebrates and more common laboratory animals as follows (1) The gallbladder empties its contents through the cystic duct, (2) the gallbladder empties by the contraction of its own intrinsic musculature, (3) the secretory pressure of the liver is not of any great significance in emptying the vesicle, and (4) intra abdominal pressure is not a major factor in the discharge of bile from the gallbladder. We shall present here certain other experimental results that further substantiate these conclusions.

Recent investigators in the field of physiology of the gall bladder are agreed that the gallbladder empties through the cystic duct, but the factors involved in the actual discharge of bile into the duodenum are yet debated questions. McMaster and Elman, Whitaker, Boyden, and Higgins and Mann, have submitted experimental evidence showing that evacuation of the gallbladder is effected by the active contraction of the muscle layer in the wall of the viscus itself. On the other hand Winkelstein and Aschner, Copher, Kodama and Graham Burget, and others, conclude, also on experimental evidence, that other factors, extraneous to the gallbladder itself, cause the vesicle to empty. These authors regard the gallbladder as but a passive agent in the flow of bile, and believe that the tonicity of the duodenal wall together with peristalsis, the elasticity of the gall bladder and intra abdominal pressure are the essential factors in the flow of gallbladder bile.

It has not been proved that the gallbladder empties its contents in response to extraneous pressure and the evidence sub-

mitted in support of this theory is speculative rather than actual Cannon has shown that the intact abdomen is comparable to an hydraulic chamber, so that pressure applied by inspiration would be equally effective on all portions of the biliary and the gastro intestinal tracts and, as a result, could not be effective in emptying the viscus

Changes in intra abdominal pressure might be a factor in the emptying of the gallbladder if the increase in intra abdominal pressure could be exerted on the wall of the gallbladder before the duodenal wall is reached or if the duodenal wall were incapable of being affected by the change in pressure Neither of these postulates have so far been proved Studies now in progress at our laboratory show that the gallbladders of laboratory animals empty under experimental conditions in which intra abdominal pressure is entirely eliminated Two copper tanks electrically heated and thermostatically controlled, have been constructed one suitable for smaller animals rabbits and guinea pigs, and the other for dogs Each tank has an opening in one end sufficiently large to permit the protrusion of the head of the animal under observation so that normal respiration may continue during the experiment In this way the abdomen of the subject may be opened under proper anesthesia, and the liver, gallbladder and duodenum carefully exposed The entire body is then immersed in physiologic sodium chlorid or Ringer's solution, the temperature of which is kept at from 37° to 39° C Under these conditions the gallbladder and the entire biliary tract remain constantly visible and direct studies of the process of emptying are made possible Thus far we have studied the mechanism of the flow of bile in both rabbits and guinea pigs, in these animals the exposed gallbladders usually empty in response to the fat meal, known to induce the discharge of gall bladder bile in the intact animal Observations on the guinea pig entirely confirm the results of our earlier studies on the physiology of the entire extrahepatic biliary tract in this animal Gallbladders of animals under the experimental conditions described, do not empty until after the administration of the test meal either by mouth or directly into the duodenum, the re

sponse is not rapid, but the vesicle contracts gradually and in two or two and a half hours evacuation is complete. It thus seems certain that any extraneous pressure, such as intra-abdominal is not necessary in the emptying of the biliary vesicle in these species.

The exact relationship of the sphincteric mechanism at the duodenal end of the common bile duct to the physiology of the gallbladder is not certainly known. Some workers in the field are of the opinion that a true sphincter of the common duct wholly apart from the duodenal muscularis does not exist, but that the discharge of gallbladder bile is due wholly to the state of tonus of the smooth muscle layer of the duodenal wall. When tonus in the duodenum is high a sphincteric effect is induced by the muscularis on the common duct, and the flow of bile is stopped. On the other hand when experimentally or normally, the tonus is lowered the sphincteric effect is removed and bile is permitted to flow from the vesicle, aided by what is known as "elastic recoil." Anatomists are not in entire accord as to the extent of a muscle layer at the end of the common duct wholly apart from the muscularis of the duodenum. Most students working on the structural relationships of the biliary tract have recognized a distinct anatomic sphincter of the common duct apart from the duodenal musculature. Numerous papers on the anatomy of the sphincter of the common duct are available, but no attempt is made to review them here, as that has been done recently by Giordano and Mann. In animals, such as the guinea pig and the rabbit in which the common duct passes more or less directly through the duodenal wall the distal portion of the duct possesses abundant circular muscle fibers which contract rhythmically in association with the flow of gallbladder bile. This is especially true in the guinea pig. By simple experiments performed in this laboratory recently, we demonstrated on a series of animals that there is a layer of muscle around the duodenal portion of the common duct sufficient to inhibit the outflow of bile, when properly stimulated. These experiments were as follows: Under ether anesthesia the biliary tract in dogs, rabbits and guinea pigs was exposed and a cannula was

inserted into the common duct pointing toward the duodenum. The duct with the cannula in place was then carefully dissected away from the duodenum so that all portions of the intestinal wall were removed and the intact duct together with the cannula alone remained. The distal portion of the duct was then connected with a pressure bottle containing Ringer's solution kept constantly at body temperature. The distal portion of the duct which was dissected away from the duodenal wall of the animal was placed on the points of an electrode. The warm Ringer's solution was then passed through the duct and the rate of flow in drops was recorded on a revolving drum before, during, and after brief periods of electrical stimulation of the region of the sphincter. It was evident that short stimulation of a restricted portion of the duct would induce contraction sufficient to produce a pressure greater than the secretory pressure of the liver or the contractile force within the gallbladder. Therefore it seems possible that a mechanism does exist at the lower end of the common bile duct, wholly apart from the duodenal wall which when properly stimulated may exert pressure sufficient to bear significant relationship to the flow of bile.

Furthermore it would appear that a more effective sphincteric mechanism of the common duct is present in those animals with a gallbladder than in those without one. If an animal is lightly etherized and the duodenal wall carefully opened opposite the site of the papillary orifice one may observe for continued periods the manner in which bile is discharged into the duodenum. In those animals possessed of a gallbladder bile emerges from the common duct in intermittent spurts as though ejected by successive muscular contractions while in animals such as the rat or the pocket gopher normally without a gallbladder bile flows more or less continuously over the mucosal surface. The manner of discharge then in the two animals is entirely divergent in one successive intermittent spurts in the other a continuous even flow. One is led to conclude that some regulatory mechanism exists in the common duct of animals with a gallbladder apart from the duodenal wall which may modify the manner in which bile is discharged.

In the foregoing observations there is no evidence that peristalsis was a factor in the flow of bile in the two animals. Bile was discharged from the hepatic tract when there were no visible signs of peristalsis. Although the sphincteric mechanism in some animals is actively muscular it probably does not affect the evacuation of the gallbladder, although it may modify it. In the guinea-pig, for example, the distal end of the common duct is enlarged to form a pulsating ampulla guarded above by a highly contractile sphincteric mechanism; but neither of these secures the discharge of gallbladder bile. Whitaker has shown experimentally that when the common duct is patent and hepatic bile is passing into the intestine in response to the administration of bile salts, the gallbladder remains distended with bile. Furthermore, the sphincter may be dilated or cut, and the common duct itself may be severed, but the viscus will not empty until stimulated either experimentally or by digestive products.

Studies on the emptying of the gallbladder included observations on fish, certain amphibia, certain birds, and many mammals. In all of these we are led to conclude that the gallbladder empties by the contraction of a muscle layer within the wall of the gallbladder. Among fishes in which the gallbladder empties completely following the usual fat diet, changes in intra-abdominal pressure due to respiration, are, of course, absent, and it is questionable to what extent peristalsis or sphincteric activity is involved. The wall of the gallbladder is certainly vastly thicker in the emptied vesicle and the picture is one to suggest the contraction of the muscle layer. Numerous observations have been made on growing and adult chickens and in all of these it is found that both the gallbladder and the duct leading to the duodenum are muscular and contractile. If a hen is lightly anesthetized and the cavity of the body opened, it is possible to empty the gallbladder by stroking it gently with a blunt instrument. Contraction waves are induced, and one may witness the course of the muscular contraction as it arises on the fundus of the gallbladder and extends on to involve the entire duct to the duodenum. The same waves of contraction charac-



tenize the activity of the hepatic duct in the pigeon. This bird is normally without a gallbladder but the hepatic duct possesses sufficient smooth muscle tissue so that its contraction induces the formation of a wave which arises at the hilus of the liver and passes to the duodenum thus insuring the discharge of bile. From these examples it is seen that in birds the discharge of bile is certainly made effective by the degree of muscular activity of the extrahepatic biliary tract.

In certain mammals at least this same interpretation becomes imperative. Authorities differ however as to the relative importance that may be attached to the muscle layer within the wall of the gallbladder. It is certain that there was a well defined smooth muscle layer in the gallbladders of animals studied and the manner of the evacuation of the gallbladder demonstrates that contraction of this muscle layer is the major factor in the process of emptying. We have recently studied and reported on the anatomy and the physiology of the entire extrahepatic biliary tract in the common guinea pig. In our earlier report (*Surgical Clinics of North America* 1926) we recorded certain observations on the emptying gallbladder in these animals all tending to support the interpretation that muscular activity is the primary factor. More recently the scope of the study has been extended and with the aid of the thermostatically controlled tank we have been able to observe under more nearly normal conditions the emptying of the gallbladder in this animal.

The gallbladder of a guinea pig fasted for eighteen hours is usually well distended with bile and in size approximates the proportions of a hickory nut. The wall of the gallbladder is relatively transparent and the finer network of capillaries is readily discernible. A microscopic section of such a distended vesicle shows it to be composed of four layers more or less definitely delineated: mucosa, fibro-elastic layer, muscularis and outer serosa. Of these layers the mucosa and the serosa are partially independent of the others but on the other hand there is considerable intermingling of the elastic fibers with those comprising the smooth muscle layer. In the distended state the mucosa comprises a single layer of columnar cells with

centrally or basally located nuclei, and, as a rule, the folds, crypts or glands, which normally characterize the mucosa of gallbladders of higher mammals, are entirely lacking. By the use of differential stains, such as Mallory's, or van Gieson's, the extent of the elastic tissue and the smooth muscle fibers is determined. Chiray and Pavel have recently studied the muscle layer of the gallbladder in the guinea pig and have shown that the muscularis comprises an outer layer of fibers of varying size, which course largely at right angles to the major axis of the vesicle and an inner layer of fibers which course in a more longitudinal direction parallel to the major axis. The fibers composing the network are usually not parallel but diverge from one another, forming an extensive network of roughly oval mesh.

In a contracting gallbladder, emptying either as a result of normal processes or by experimental means such as electrical stimulation, the changing contour of the vesicle is usually one which could only be the result of an anatomic distribution of muscle fibers such as Chiray and Pavel describe. In our earlier observations we noted that there were no contractile waves such as characterize the movement in peristalsis, but that separate areas of contraction, which gradually merged, finally effected the discharge of the contained bile. In our more recent observations on the normal animal in the tank, or on the gallbladder when electrically stimulated, we have seen the contraction of the separate areas so pronounced as to form small herniations over the surface of the vesicle. These herniations are of varying size and it would appear that they occur in the emptying of the vesicle as a result of the peculiar arrangement of the smooth muscle bundles of the muscularis described by Chiray and Pavel. These first appear over the region of the fundus and gradually increase in number and extent until the entire surface of the vesicle is involved, so that usually a completely emptied gallbladder is covered with small nodules or herniations, which give it a peculiar, knotted appearance.

Although the majority of our observations have been made on the intact animal given the usual fat diet, we have demonstrated time and again the rapidity with which the gallbladder

empties in response to stimulation either electrical or mechanical. Absolute uniformity in the response of the vesicle to stimulation of course does not exist. Living tissue reacts differently at varying times to the same environment so that occasionally gallbladders were encountered in which the response of the contractile mechanism to the stimulation employed was either long deferred or entirely absent. Simple stroking of the vesicle with a blunt instrument usually incites the contractile mechanism to activity so that one may readily see the origin and rate of change of these small herniations. Better still perhaps are the results which ensue on very brief periods of electrical stimulation. A slight contact with a small current is invariably sufficient to incite contraction of the muscle bundles and one may time the interval necessary to evacuate the gall bladder completely by this method. Observations on a large number of fasted guinea pigs were made to determine the interval of time required to empty a well distended gallbladder following brief stimulation by an induction current. In each animal so observed the duodenum was suspended well above the level of the gallbladder so that gravity could not be a factor in the flow of bile from the vesicle. In some animals the response of the muscularis to the electrode was immediate while in others the action was delayed. In each case no doubt the response produced was the result of numerous factors. The particular physiologic tone of the muscularis stimulated together with tonus of the duodenum and the status of the sphincter of the common duct are factors which would modify the rate at which the vesicle might empty. Accordingly there was a wide range in the interval of time from the moment the stimulus was applied to complete evacuation varying from three to seven minutes.

Histologic studies of a contracting gallbladder are of striking interest. The inner surface of the mucosa of a distended gall bladder is practically smooth but immediately on contraction numerous small folds of the mucosa extend into the lumen of the vesicle. The cells composing the mucosa become even more compressed and frequently cells come to lie superimposed as

though they were literally forced one over the other. As further contraction ensues, the folds of the mucosa become more pronounced, and involve the entire lumen of the vesicle. Frequently sections of a gallbladder in the contracted state have been noted in which corresponding folds of opposing sides of the gallbladder have become contiguous, forming an extensively branching network of such folds. As these folds form, the elastic tissue extends out into them as wedges between the layers of the mucosa, but the smooth muscle tissue remains restricted to the external portion of the wall of the contracting vesicle. The muscle fibers are correspondingly shorter and the entire wall is relatively thicker, all of which substantiates our contention that the entire process of emptying is a function of this muscle layer. Furthermore, during contraction large crypts arise within the elastic layer, formed by out pocketings of the mucosa into the outer layers of the vesicle. These crypts or sinuses communicate by small ostia with the gradually decreasing lumen of gallbladder. Our observations on the emptying gallbladder of the guinea pig, considered from the physiologic, the anatomic or the histologic viewpoint, leads us to conclude that the gallbladder empties its bile by the contraction of its intrinsic musculature, in conjunction with the sphincteric mechanism at the lower end of the common bile duct.

The inciting factors which cause the gallbladder to contract are still unknown. Boyden, and others, have secured partial emptying of the vesicle by merely inserting a hypodermic needle into an animal which indicates that the response might be sympathetic. In experiments on the human subject, Boyden has secured a response in the gallbladder within a few minutes after a meal of egg yolk and cream. Thus far our observations have led us to conclude that the factors inciting contraction of the gallbladder were in some way associated with absorption. We have never witnessed even partial emptying immediately on the administration of the test meal in any of our experimental animals. It was not until a certain amount of digestion had ensued and until the lacteals of the intestinal mesenteries were at least partially filled that the gallbladder began to empty.

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bile This condition was found repeatedly, only rarely was there evidence that any emptying of the viscus had occurred. Since we could not expect fetal gallbladders to empty when the stimulus to cause emptying of the maternal gallbladder was absent we gradually prolonged the interval between the giving of the food and operation in successive experiments. We learned that it was not until after ten or twelve hours had elapsed that there was any response within the gallbladder, and even this response was slight in most of the dogs explored. In other words, we were forced to the conclusion that the gallbladders in pregnant dogs do not empty in the manner or to the degree that they do in the nonpregnant animal. Accordingly it would appear that pregnancy had an inhibitory effect on the emptying of the biliary vesicle.

In order that our study of the relationship of pregnancy to the gallbladder could go on, and since pregnant dogs although entirely satisfactory animals, could not always be secured in sufficient number, we selected the common thirteen striped gopher for further observation. Soon after these animals emerged from hibernation when they were at the height of sexual activity large numbers of them were collected in the fields and brought to the laboratory for study. Three groups of animals were used in the experiment, males, nonpregnant females and pregnant females, the males and nonpregnant females serving as controls.

The gallbladder of the striped gopher is of good size and when well distended (as in the fasting state) it is about the size of a hazel nut. When fasted males or nonpregnant females were given 7 c.c. of egg yolk and cream, by tube exploration four hours later showed that the gallbladder was invariably empty. Here again the emptying was always associated with the extent of intestinal absorption for when the lacteals and the mesenteric lymph nodes were white, the gallbladders were empty. In animals that were killed six or seven hours after ingestion of the fat meal the gallbladders were almost full. The test for bilirubin concentration in these gallbladders showed that they had emptied and that they were refilling at this time after the meal.

These facts were invariable for the thirteen striped gopher that the gallbladder emptied completely in from three and a half to four and a half hours that it began to fill in from five to six hours and that at eight hours after the meal it was again distended with bile

The results of our study on the pregnant gopher were vastly different and agreed with our earlier observations on the gall bladders of the pregnant dog When a fasted pregnant gopher near term was given 7 c c of egg yolk and cream and killed four hours later the gallbladder was completely distended Even though we increased the interval of time between the feeding and the exploration of the animal we never saw an emptied gallbladder in a gopher late in pregnancy This was true even though absorption throughout the intestine was fairly complete The reaction of gallbladders of animals in early pregnancy differed somewhat in that emptying was partial When the fetuses were but slightly larger than the fecal material within the colon of pregnant animals the gallbladder was partially emptied four hours after the usual meal of egg yolk and cream The degree of emptying of the vesicle seemed correlated with the extent of development of the young In pregnant females at about half term the gallbladders emptied slightly after the meal while in females at full term invariably the gallbladders were completely distended with bile four six or even ten hours following the meal

Since our conclusions are based on observations of a large number of animals we are forced to conclude that at least in these species gallbladder activity and pregnancy bear some significant relationship to each other Just what this relationship may be or how pregnancy modifies the discharge of gall bladder bile remains a problem for further study Inasmuch however as the gallbladders of gophers in early pregnancy emptied partially and that the degree of emptying seemed in some way correlated with the size of the fetuses the question arose as to the bearing that intra abdominal pressure might have on the viscus We were thereupon tempted to try a series of experiments in which we would simulate the pressure factor of preg

nancy Accordingly, males, nonpregnant females, and females already with young were lightly anesthetized, and, using sterile technic, the abdomens were opened and paraffin balls, equal in displacement to the average uterus at term, were placed directly into the peritoneal cavity The animals speedily recovered, and in from ten days to two weeks they were given the usual test meal to determine whether or not the gallbladder could empty under the abnormal conditions When the animals were killed four hours following the meal, with but a few exceptions, the gallbladders were completely empty In the cases in which the gallbladder remained distended, paraffin masses had moved forward in the peritoneal cavity and had become impacted against the gallbladder or the common duct, mechanically inhibiting the flow of bile In such cases edema of the gallbladder had developed and a pathologic condition modified the normal response However, in all other cases in which the foreign masses remained apart from the biliary tract, the gallbladders emptied in the usual way These observations, although incomplete in many respects, and perhaps subject to a certain degree of criticism, lead us to conclude that the inhibition to the emptying of the gallbladder of the pregnant animal is not correlated with a factor of intra abdominal pressure Certain other factors, perhaps of chemical or of metabolic nature, are involved, the determination of which are subjects for further study and research

Since the biliary tracts of various species differ so markedly both anatomically and physiologically, facts determined experimentally must be applied cautiously to the human being However, it would seem logical to believe that in man there is also a special mechanism at the end of the common bile duct which has to do with the filling of the gallbladder, and that the gallbladder also empties its contents by its intrinsic musculature If it is found that the gallbladder of the pregnant woman does not empty in the same manner as that of the nonpregnant woman, one of the factors causing the high incidence of cholecystic disease, particularly gallstones, following pregnancy, may be determined



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# URIC ACID EXCRETION IN EXPERIMENTAL HEPATIC INSUFFICIENCY

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THE marked increase in the uric acid content of the blood, urine and tissues of dogs following complete removal of the liver immediately suggests that the liver is primarily concerned with the destruction of uric acid. It has been shown that such destruction which is rapid and marked in the normal dog does not occur if the liver is entirely removed. The wide difference between the excretion of uric acid by normal dogs (only a few milligrams in twenty four hours) and the large amount excreted by completely dehepatized animals led us to investigate the uric acid excretion under various experimental conditions. In those conditions in which the liver was definitely effected we found changes in the uric acid excretion which were sufficiently marked to warrant their publication.

## PREVIOUS WORK ON URIC ACID IN RELATION TO THE LIVER

Since several authors have published general reviews of the subject of uric acid metabolism only such articles as seem intimately related to this study will be noted here. A complete review may be obtained from the works of Folin, Rose, Jones, Benedict, Ullmann and Folin, Berglund and Derick.

Minkowski found marked decrease in the uric acid content of the urine of geese following hepatectomy. Administration of urea to these animals did not increase the uric acid excretion as it does in normal birds which clearly demonstrates that the power of synthesis of uric acid from urea is lost when the liver of these animals is removed. Von Mack repeating these experiments found that the uric acid did not entirely disappear from the urine of dehepatized birds because of the two sources of uric acid in these animals namely throughout the body

from metabolic processes and in the liver as the result of its synthesis from urea which takes place only in this organ

The work of Pawlow and his pupils is often quoted as demonstrating that the liver of mammals also plays a part in the metabolism of uric acid. Following the production of Eck fistula in dogs they found that the urine contained larger amounts of uric acid. They attributed the excess uric acid in the urine to the failure of the liver to oxidize uric acid. Abderhalden, London, and Schittenhelm found that this increase in the excretion of uric acid was compensated for by a corresponding decrease in the excretion of allantoin.

Perroncito removed the liver from dogs with Eck fistula so that there was no portal stasis. The animals excreted urine containing such high concentrations of uric acid that crystals precipitated on cooling. Beside the large amount of uric acid excreted there was marked increase in the uric acid content of the blood. Mann and Magath have reported on this same observation following hepatectomy in the dog. Perroncito also removed the liver from dogs and simultaneously ligated the renal arteries and veins. The animals survived for from one to four hours after operation during which time there was a definite increase in the uric acid content of the blood. Control animals in which the renal arteries and veins were ligated as well as the common and cystic ducts showed no increase in the uric acid content of the blood. He concluded that the accumulation of uric acid in the blood of dehepatized animals was due to lack of destruction of uric acid.

Folin, Berglund, and Derick made an extensive study of the behavior of uric acid within the body. They attempted to determine the site of destruction of uric acid. They demonstrated that uric acid injected intravenously in the dog was destroyed rapidly, 70 per cent disappearing in the first ten minutes after injection. Excretion of uric acid by the kidneys is a minor factor in its disappearance because only traces of the injected acid are found in the urine and it also disappears from the blood rapidly even if the kidneys are removed. The renal tissue in the normal dog seems to be the only tissue capable of absorb

ing uric acid from the blood stream since little can be detected in any other even if the uric acid content of the blood is greatly increased. These authors therefore concluded that this rapid destruction of uric acid took place in the circulating blood. Blood from the femoral artery and vein contained similar amounts of uric acid after injection and loss of uric acid could not be demonstrated in the blood passing through the hind leg of the dog. The disappearance of uric acid from the blood following injection into a dog with Eck fistula was also rapid. Further experiments demonstrated that uric acid injected into the portal vein could pass through the liver since more uric acid was found in the kidneys than in the liver. It was also noted that the uric acid in the heart's blood was greatly increased and it was shown that uric acid could be absorbed from the intestine with sufficient rapidity to cause an increase in the uric acid content of the peripheral blood.

Bollman, Mann and Magath found that large amounts of uric acid appeared in the urine of dogs following hepatectomy which also gives rise to an increase in the uric acid content of the blood. Uric acid injected intravenously into animals following hepatectomy may be almost quantitatively recovered in the urine. Uric acid injected into animals with the liver and both kidneys removed is slowly absorbed by the muscles so that it does not all remain in the circulating blood. Determination of the uric acid content of the blood and muscles several hours later shows that the total amount is retained in the body and that but little of it could have been destroyed. The uric acid accumulated in the body of the dog after hepatectomy and nephrectomy is of the same magnitude as that excreted by the kidneys after hepatectomy alone. The uric acid excreted by the dehepatized animal is of the same magnitude as the allantoin excreted by the normal dog. The destruction of uric acid in the normal dog depends on the presence of the liver as this process ceases as soon as the liver is removed.

We have studied most of the tests that have been suggested for measuring hepatic function. Normal animals, animals with an Eck fistula, animals with permanently reduced amounts of

hepatic tissue, and animals with the liver completely removed, were used. From the data thus obtained we drew certain conclusions. Tests for bilirubin in the blood, such as the van den Bergh, should be of value as a measure of a condition in which the liver is either *directly or indirectly*, but not necessarily exclusively, affected. The physiologic basis for the use of the dyes which have been employed as tests of hepatic function is the fact that they appear to be excreted mainly by the liver. There is definite experimental basis for the elaboration of a test of glycogen mobilization which might bear the same relation to the activity of the liver in relation to carbohydrate metabolism as the quantitative bilirubin test does to pigment metabolism. The best test yet found of functional deficiency of the liver in the dog is based on the facts that destruction of uric acid depends on the liver, that *this is the most easily injured of the known functions of the liver*, and that the amount of uric acid excreted in the urine appears to bear a definite relation to hepatic injury. We found that a diet rich in nuclear material gave rise to increased excretion of uric acid and that the increase in uric acid in the urine was greatest in animals in which the impairment of the liver was greatest.

Ullmann estimated the uric acid excretion of several groups of patients who had been on a purin free diet. The only outstanding relationship was found in the extremely high values obtained in cases of acute and subacute yellow atrophy, and the severity of the case could be judged by the amount of uric acid in the urine. In many other conditions in which the liver was involved, as hemolytic jaundice, obstructive jaundice, cirrhosis, malignant metastasis to the liver, and catarrhal jaundice, the excretion of uric acid was within normal limits.

#### EXPERIMENTAL INVESTIGATION

Studies of uric acid metabolism have been made in normal animals and these data compared with similar procedures in animals with impaired livers. These may be considered in three groups: animals with obstructive jaundice following ligation of the common bile duct, animals with an Eck fistula (ligation of

the portal vein above an anastomosis of the portal vein with the vena cava), and similar animals in which a portion of the liver had been removed surgically. Specimens of blood were obtained with a dry syringe from the jugular vein and mixed with powdered potassium oxalate in dry tubes. Specimens of urine were obtained from metabolism cages, or by catheterization, and washing the bladder. If the urine was desired at definite intervals, the animal was catheterized and the bladder washed at the beginning and end of the desired period. The content of uric acid in the blood and urine was determined by the method of Folin and Wu.

The blood of the normal dog contains only a trace of uric acid. This appears to be rather independent of the diet and is seldom found to be more than 0.3 mg. per cent. The amount of uric acid excreted in the urine in twenty-four hours is likewise small. The fasting dog excretes only a few milligrams of uric acid a day, and only a slight increase is noted when the animal is on an ordinary diet. Meat feeding. 200 gm. of meat daily, increases the uric acid excretion from 40 to 100 mg. a day with the average about 60 mg. When a diet rich in purins is fed to the normal dog the excretion of uric acid is further increased. Following an eighteen-hour fast, animals fed 175 gm. of pancreas excrete from 80 to 160 mg. of uric acid during the twenty-four hours after feeding, with the average about 120 mg. The results obtained by observing the disappearance of injected uric acid from the blood are also interesting. Forty milligrams of uric acid for each kilogram of body weight were injected intravenously and the uric-acid content of the blood determined five, fifteen, thirty, sixty, ninety, and one hundred twenty minutes afterward. In the normal animal an increase of from 2 to 3 mg. of uric acid for each 100 c.c. of blood is obtained at the end of five minutes after injection; ten minutes later this has almost disappeared, and thirty minutes after injection the uric-acid content of the blood is normal again. Only a trace of uric acid appears in the urine at the end of two hours.

Following ligation of the common bile duct the uric-acid content of the blood remains normal for the first five or six

weeks of obstructive jaundice. After this time a definite increase in the uric acid content of the blood is frequently found and in several instances we have noted marked rise in the uric acid content of the blood a few hours before death from continued obstructive jaundice. If 40 mg of uric acid for each kilogram of body weight is injected intravenously it disappears from the blood at about a normal rate except in the later stages of obstructive jaundice. During the terminal stages it has been found that the increased content of uric acid in the blood persists for a longer time and that considerably more of the injected uric acid is obtained in the urine. The amount of uric acid excreted in the urine in the early stages of obstructive jaundice remains within normal limits. The feeding of a high nuclear diet (175 gm of pancreas) is not followed by a much greater excretion of uric acid than in the normal animal. During the later stages of obstructive jaundice this diet increases the uric acid excretion varying from 200 to 500 mg a day. We have not been able to determine any apparent relationship between the duration of the obstructive jaundice and the excretion of uric acid. There does appear however to be a rough proportionality between the degeneration and atrophy of the liver as estimated by gross and microscopic examination and the amount of uric acid excreted. This is more noticeable when the diet of pancreas is given.

Following the production of Eck fistula in dogs there is considerable although variable atrophy of the liver. This is evidenced by the reduction in the weight of the liver and also by the degenerative changes found in microscopic sections of these livers. The uric acid of the blood remains within normal limits after the Eck fistula has been established. The disappearance of injected uric acid from the blood is delayed. Following the injection of 40 mg of uric acid for each kilogram of body weight of the animal there is an increase of from 3 to 5 mg of uric acid for each 100 cc of blood five minutes after injection. Ten minutes later the excess is only 1 or 2 mg and later there is a gradual decrease so that at the end of from ninety to one hundred twenty minutes the uric acid content

of the blood is normal again. From 2 to 10 per cent of the uric acid injected is recovered in the urine. The urine of the fasting animal with Eck fistula contains an increased amount of uric acid, but this does not appear to be related to the duration of the fistula. There is considerable variation from time to time in the amount of uric acid excreted and there is what roughly appears to be a corresponding variation in the hepatic atrophy present. The variations in the hepatic atrophy following Eck fistula seem to be partly attributable to variations in the blood supply to the liver (due to the ingress to the liver of collateral vessels from the surrounding structures and from what adhesions may be present); it would also appear that the nutritive state of the animal exerts a great influence on the condition of the liver. Following the feeding of 175 gm. of pancreas these animals excrete from 120 to 750 mg. of uric acid or an average of about 450 mg. a day. Estimations of the amount of hepatic atrophy, made either at exploration or at necropsy, indicated that much more uric acid was excreted when the amount of hepatic atrophy was greatest.

Surgical removal of portions of the liver from animals with an Eck fistula is followed by only slight restoration of hepatic tissue; thus we have been able to reduce the amount of hepatic tissue permanently to only a small percentage of the normal. By careful dietary measures, animals so treated may be maintained in good condition for several years, and after a short time there seems to be little change in the gross or microscopic appearance of the hepatic tissue. The blood of these animals frequently contains increased amounts of uric acid. Large increases in the uric-acid content of the blood were found only in those animals from which so much liver had been removed that they survived operation only a few days. The injection of standard amounts of uric acid into these animals produced a greater rise in the uric acid content of the blood, and the disappearance of the increased content of uric acid from the blood was greatly delayed. The delay in the disappearance of uric acid from the blood appeared to depend on the amount of hepatic tissue that had been removed from the animal. Greater



amounts of the uric acid could be recovered in the urine. The urine from fasting animals in this condition contained from 100 to 400 mg of uric acid a day. When these animals were given a heavy meat diet more uric acid was excreted. Following the feeding of 175 gm of pancreas from 600 to 900 mg of uric acid was excreted or an average of about 700 mg. The amount of uric acid excreted was quite constant for the individual animals of this series and increased in proportion to the amount of reduction of hepatic tissue (Tables 1-3).

TABLE 1

EXCRETION OF URIC ACID FOLLOWING FEEDING OF PANCREAS TO NORMAL DOGS

Dog	Date	Weight kg	Total nitrogen mg	Uric acid mg
1851	2/15/26	13.5	6800	122
	2/17/26	13.5	6634	129
1852	2/17/26	9.2	6000	128
G849	12/8/25	15.0	6750	80
	12/14/25	15.0	6000	80
H509	11/10/25	12.8	6040	154

TABLE 2

EXCRETION OF URIC ACID FOLLOWING FEEDING OF PANCREAS AFTER ECK FISTULA

Dog	Date	Weight kg	Days after operation	Total nitrogen mg	Uric acid mg
1851	2/22/26	13.5	3	6273	183
	3/10/26	13.5	19	6565	234
1852	2/22/26	9.2	3	4812	300
	3/10/26	8.8	19	5720	720
	3/29/26	8.7	38	6264	515
G737	12/21/25	13.8	5	6048	422
	1/5/26	12.8	20	5538	682
	1/19/26	12.6	34	6000	522
G849	12/21/25	15.0	5	7100	455
	1/5/26	15.0	20	4480	640
H509	11/24/25	11.9	13	4720	335
	11/30/25	11.7	19	5376	656

TABLE 3

EXCRETION OF URIC ACID FOLLOWING FEEDING OF PANCREAS AFTER OPERATIONS ON THE COMMON DUCT AND LIVER

Dog	Date	Weight kg	Condition of animal	Period after operation	Total uric acid mg.	Uric acid mg.
I 31	2/9/26	5.9	Obstructive jaundice	72 days	35.4	133
I 33	2/9/26	5.6	Obstructive jaundice	22 days	4.00	80
I 35	2/9/26 2/22/26	5.5 5.5	Obstructive jaundice	54 days 68 days	4.68 43.54	457 14
I 39	2/9/26 2/22/26	6.4 6.2	Obstructive jaundice	55 days 64 days	57.00 51.00	94 234
G 49	1/19/26	13.8	After partial hepatectomy	6 days	5.48	855
G 51	1/27/26	11.9	After partial hepatectomy	6 days	5.130	56
H 39	12/27/25	12.1	After partial hepatectomy	15 days	52.80	600
H 35	12/18/25 1/19/26	11.0 11.2	After partial hepatectomy	7 months 8 months	60.90 58.18	6.0 681

## DISCUSSION

There can be little doubt that the destruction of uric acid in the dog depends entirely on the liver and it would seem from our experiments that this function of the liver is most easily impaired. We can obtain evidence of the impairment of hepatic function by determining the rate of destruction of uric acid in an animal in which no other evidence of decreased hepatic function can be obtained. There is also definite evidence to indicate that the destruction of uric acid is affected quantitatively by injury to the liver.

It might appear that the determination of the rate of disappearance of excess uric acid from the blood would be a most effective means of estimating the functioning capacity of the liver. However, there are two objections which should be raised to the use of injections of large amounts of uric acid as a test for hepatic function. First, injections of large amounts of uric acid produce severe lesions in the kidneys and interfere with excretion. The power of the kidney to absorb uric acid from the blood is interesting since extremely high concentrations of uric acid are found only in the kidney after injection and this condition is normally found in birds and reptiles which excrete uric

acid as a solid. Second in man particularly, retention of uric acid in the blood may be caused by lesions of the kidneys, in the dog the presence or absence of the kidneys is without effect on the rate of disappearance of injected uric acid from the blood.

Our results following the feeding of pancreas or of any material rich in nucleins were satisfactory tests for hepatic function in the dog. Since the destruction of uric acid has been found to take place in man although at a greatly reduced rate, it would appear that this method might be of some value in clinical studies of hepatic function.

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## SUBACUTE, ACUTE, AND POSTOPERATIVE INTESTINAL OBSTRUCTION

WALTMAN WALTERS

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THE difference between subacute and acute intestinal obstruction is not only the degree of obstruction but the intensity of the accompanying toxemia. Any condition tending to interfere with the neuromuscular control of any segment of intestine may be the cause of incomplete or subacute obstruction. In practically all such cases the disturbance of the resulting peristaltic action is not accompanied by disturbance of the blood supply of the intestine, in contrast to acute intestinal obstruction in which interference of blood supply to the involved loop of small intestine is not infrequent.

### SUBACUTE INTESTINAL OBSTRUCTION

Usually the clinical picture of subacute intestinal obstruction is occasional vomiting, practically never fecal, a moderate degree of distention of the abdomen, a noticeable decrease in the amount of gas and fecal material passed from the rectum, and facies that would not lead one to suspect intra-abdominal lesion. The most characteristic example of this occurs in cases of neoplastic lesions of the large intestine.

In acute intestinal obstruction one has to deal, in most cases, not alone with the factors initiated by the obstruction, but with the toxemia resulting from a disturbance of blood supply of the involved segment of the small intestine which may become gangrenous. The clinical picture, therefore, differs from that of incomplete obstruction in that besides the vomiting, abdominal distention and constipation, the patients appear and are critically ill, and usually the vomiting is fecal in char-

acter and there is fever increased pulse rate and leukocytosis. Under such circumstances immediate operation is necessary since relief of the obstruction is paramount.

The frequency with which an appendix repeatedly insulted by infection may give rise to marked indurative perityphlitis was alluded to in the Surgical Clinics of North America last year and a safe method of coning out the appendiceal mucous membrane in such cases was described.

In a recent case in which operation was performed the inflammation and induration had proceeded to such a stage that incomplete intestinal obstruction had occurred with blocking of the ileum at the cecum. In brief the patient a woman aged forty seven gave a history of having had repeated attacks of acute appendicitis for twenty years. During an attack five years previously she was extremely ill and was told by her physician that the appendix had perforated. In June 1926 she had a severe attack of epigastric pain which left her with residual soreness in the appendiceal area. This soreness and pain was aggravated by eating. Of late she had had spells of vomiting. She noted a marked decrease in the ability to pass gas and fecal material from the rectum.

On physical examination peristaltic movements of the intestine could be discerned in the lower part of the abdomen with the peristaltic current from left to right. There was a mild degree of abdominal distention.

At operation a mass 7.5 cm. in diameter consisting of the cecum and a small remnant of the appendix was found. The indurative inflammation had obstructed the terminal ileum so that the wall was ballooned approximately to four times normal size and resembled the large intestine. After the terminal ileum had been emptied of approximately 500 c.c. of fecal like material the remaining segment of appendix was removed and ileocolostomy performed (Fig. 749). The patient made an excellent recovery and a letter from her in August, 1927, stated that she had remained well and had gained several pounds in weight.

The tendency for increasing pain in the lower right side of the abdomen after eating in other types of incomplete intestinal

obstruction adjacent to the terminal ileum appears to be a rather constant factor. It was present in a young man aged twenty



Fig. 49 — Infection of cecum with an ileocolostomy made to ascending colon

seven who had had intermittent attacks of knife like pains over the right lower quadrant of the abdomen for about two months. The attacks lasted for about five minutes and were succeeded



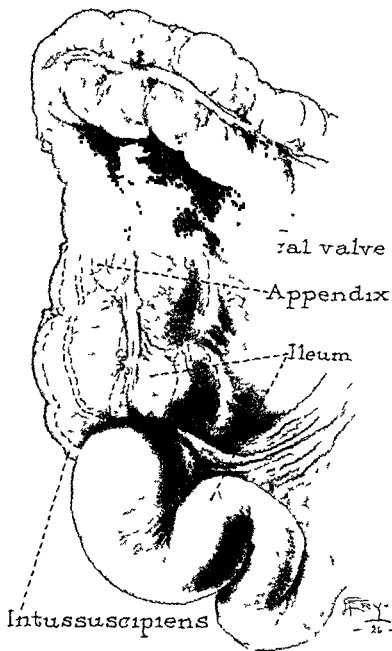


Fig 750 —Intussuscepted ileum appendix and cecum in adult

by residual soreness of about ten minutes. The pain radiated toward the navel and although frequently accompanied by nausea, there had been no vomiting.

At operation ileocecal intussusception was found and reduced, and appendectomy performed. In order to prevent recurrence

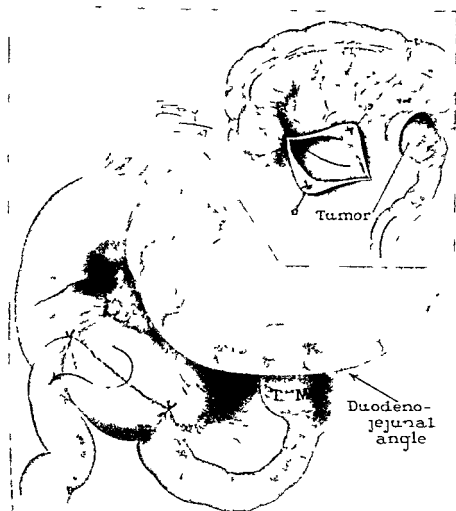


Fig 751 —Tumor of duodenojejunal angle with opening made between duodenum and jejunum. Insert: Incisions which are to be approximated.

of intussusception the cecum and ileum were sutured to the parietal peritoneum (Fig 750). The frequency of intussusception in adults is quite low. The short duration of the knife-like pains

and their intermittent appearance was a signal of disturbance of small intestine motility

Studying the relative frequency of carcinoma of the small and large intestines and stomach at the Mayo Clinic Judd in 1919 noted twenty four carcinomas of the small intestine as compared with 1 822 of the large intestine and rectum and 1 689 of the stomach Eleven occurred in the jejunum five in the duodenum and six in the ileum

Clark, in a recent paper reported a case of carcinoma of the ileum and summarized the literature on carcinoma of the small intestine

December 2 1926 I operated on a woman aged sixty five for *incomplete intestinal obstruction from a neoplasm probably carcinoma* attached to the body of the eleventh and twelfth thoracic vertebræ and producing obstruction at the duodenojejunal angle (Fig 751) She complained of having experienced dull pain in the left upper quadrant of the abdomen for two months indefinite dyspepsia with increasing constipation and loss of 13 pounds in weight

Nothing abnormal was felt on palpation of the abdomen A gastric test meal showed absence of free hydrochloric acid Fluoroscopic examination of the stomach and duodenum showed marked obstruction 30 cm from the pylorus The patient complained of fullness in the stomach subsequent to the fluoroscopic examination and the passage of a stomach tube disclosed gastric retention of 2 000 c c The blood was practically normal urea 42 mg for each 100 c c chlorides 640 mg and carbon dioxide combining power 45 per cent by volume

At operation a fixed tumor 5 cm in diameter was found attached to the eleventh and twelfth thoracic vertebræ which was obstructing the duodenojejunal angle The fixation of the tumor made its removal impossible The walls of the duodenum were hypertrophied and the caliber was increased considerably above normal Duodenojejunostomy was performed with relief of the obstructing symptoms

The patient gained considerably in weight August 1927 she returned for examination, complaining of pain along the

distribution of the nerve roots of the eleventh and twelfth dorsal nerves. Again, nothing abnormal was found on examination of the abdomen and pelvis. Roentgenograms of the spine, however, showed considerable destruction of the eleventh and twelfth dorsal vertebræ, apparently from a growing neoplasm.

### ACUTE INTESTINAL OBSTRUCTION

The incarceration of a loop of small intestine with strangulation of its lumen and blood supply in an old inguinal or femoral hernia, is one of the most common causes of acute intestinal obstruction. The danger in strangulated hernia is dependent on the degree of strangulation and the possibility of gangrene, while the risk of operation depends on the patient's general condition as well as the extent of the operative procedures necessary to save life. The simple procedure of incising under local anesthesia and draining such a strangulated loop, may save the life of an elderly patient. Later, entero anastomosis or resection of the intestine may be performed when the toxemia of obstruction and strangulation are not insurmountable handicaps.

In one case that of an elderly woman, aged seventy nine, with a strangulated hernia of twenty four hours' duration, the gangrenous loop of small intestine was removed extraperitoneally as it lay in the inguinal canal. A catheter sutured into the proximal end of the intestine served as an enterostomy and a clamp placed on the lower end of the intestine distal to the gangrenous area permitted extraperitoneal resection of the gangrenous segment (Fig 752). The extraperitoneal resection, without attempting entero anastomosis, was undoubtedly a life saving procedure.

The patient was out of bed on the fifth day following operation, and was able to return to her home, about fifteen miles distant, at the end of two weeks. The reestablishment of intestinal continuity by the clamp pressure necrosis method of Mickulicz was contemplated. Unfortunately, her condition never permitted this, she died some weeks later.

A man, aged seventy seven, entered the hospital complaining of vomiting and constipation for three and a half days. High



# THE ORIGIN AND TREATMENT OF FISTULA-IN-ANO

LOUIS A. BUIE

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THE term "fistula in ano" designates a discharging sinus or sinuses with one or more openings in the anal canal and an opening or openings externally or into a neighboring viscus (vagina, bladder, urethra, uterus, prostate, seminal vesicles or bowel). The anus is always the primary seat of the disease and from the original infection in one or more of the anal crypts, the disease progresses through various stages to fistula formation. It is important to keep this in mind, because in the search for the internal opening there is a general tendency to pass beyond the margin behind which the crypts are situated and look too high. With few exceptions, these internal openings are in the anal crypts, recognition of this fact will aid one materially in ferreting out the tracts to their origin a procedure which is indispensable if cure is to be attained.

## INCIDENCE

During the period from January 1, 1922, to December 31, 1926, there were 721 cases of ischiorectal abscess and anal fistula observed at the Mayo Clinic, an incidence of 0.23 per cent of all registrations. During the same five years there were 16,425 patients suffering from rectal complaints and the incidence of anal fistula and ischiorectal abscess among this group was 4.38 per cent.

The distribution according to sex showed a definite prevalence among males. There were 445 males (61.71 per cent) and 276 females (38.29 per cent). The average age in the series was about forty-one years. Only eight patients were less than twenty years of age, and 547 (75.8 per cent) were between the ages of twenty and fifty years.

## EMBRYOLOGY

A proper concept of the development of anal fistula can be based only on a clear understanding of the embryologic and

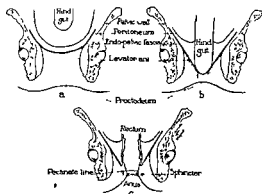


Fig 755 —Diagrams to illustrate the formation of the anus and the pectinate line (From Pennington)

anatomic characteristics of the pectinate line Pennington provided an admirable description of this in his textbook on the *rectum, anus, and pelvic colon*

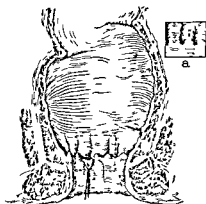


Fig 756 —Dentate line, papillae of Morgagni, horizontal folds and anal sphincters, a, crypt of Morgagni.

In the embryo the hind gut projects downward to meet the proctodeum (Fig. 755, a, b, c), ultimately forming the pectinate line where the skin unites with and overlaps the mucous mem-

brine in a serrated margin. The skin projections are the papillæ and the crypts behind them were first described by Morgagni and bear his name, as do also the folds known as the columns of Morgagni (Fig 756). These are horizontal folds of mucous membrane which result from the purse string effect of the internal sphincter around the lowest segment of the rectum.

### ANATOMY

The pectinate line or dentate margin is an important anatomic landmark, since at this level there is a change in the arrangement of structures above and below it (Fig 757) as follows.

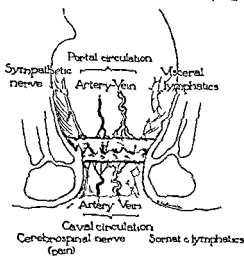


Fig 757 —Diagram of the nervous, vascular and lymphatic supply above and below the pectinate line. (From Pennington.)

**Arteries** —The superior hemorrhoidal artery arises from the inferior mesenteric and, with the middle hemorrhoidal which is derived from the internal pudic or inferior vesicle, supplies the rectum and anus down to the pectinate line. The source of the middle hemorrhoidal is inconstant, sometimes it arises from the internal iliac. The inferior hemorrhoidal artery originates as a branch of the internal pudic and supplies the anus, posterior perineum, levator ani and the anal sphincters with from one to four branches.

**Veins** —The superior hemorrhoidal vein collects the blood from above the dentate margin and empties it by way of the



inferior mesenteric into the portal circulation, whereas the inferior hemorrhoidal vein delivers the blood from the lower part of the anus and its margins into the internal pudic and thence into the vena cava. At the anus there is an anastomotic network of the superior middle and inferior hemorrhoidal veins.

**Lymphatics**—The superior lymphatic zone drains the rectal mucosa into lymph nodes of the mesorectum and mesosigmoid. The middle zone collects into nodes about the middle hemorrhoidal artery. The inferior zone has from three to five trunks under the skin at the verge of the anus and drains through branches which pass over the perineum and into the inguinal nodes.

An interesting error in this connection is worth relating. A patient reported at a city dispensary complaining of an abscess of the groin. The abscess was lanced and because of the history of previous illnesses syphilitic treatment was instituted. Time went on and the discharging sinus in the groin persisted. Ultimately the patient called attention to the fact that he had complained at his first visit of anal pain during and after defecation and that the pain had persistently grown worse. Examination of the anus revealed a fissure, this was excised and the discharging sinus in the groin healed promptly.

**Nerves**—The nerve supply above the pectinate line is sympathetic and below it is cerebrospinal. Hence the slightest trauma to the papillæ or the anal margin is very painful, whereas trauma to the rectal mucosa itself is unproductive of discomfort. It is because of this that we are deprived of an important diagnostic aid in cases of rectal and sigmoidal carcinoma. Discomfort is not evident in these cases until the deeper perirectal and pelvic structures are involved, or until obstruction causes distention of the colon above the lesions.

## ETIOLOGY

Whenever fistula in ano is being discussed someone invariably interjects a query as to its etiology. Immediately, the subject of tuberculosis claims attention and the conclusions depend on the nature of work being done by the debaters, the general

surgeon leaning away from the significance of tuberculosis as a cause, and the specialist in tuberculosis emphasizing it. There was a time when many thought that practically every case of fistula-in-ano was caused by tuberculous invasion of the ischio-rectal tissues. There are few who maintain this viewpoint now, although recently, while corresponding with a number of authorities in tuberculosis hospitals in the United States, I received replies of a startling character from two of them. One expressed it as his belief that "all anal fistulas and ischio-rectal abscesses" are tuberculous, and another thought that the "incidence of tuberculosis in anal fistula is at least 90 per cent." All of the letters that I received contained statistics which I am presenting in order to show the frequency of anal fistula and ischio-rectal abscess in cases of tuberculosis. I collected 9,668 cases in ten of the leading tuberculosis hospitals in this country and found a total of 264 (2.73 per cent) with anal fistula or ischio-rectal abscess. Hennigar, of the Trudeau Sanitarium, states that since 1909 there have been 4,160 patients in that institution. In the same period there were twenty-one cases of fistula-in-ano, and twenty-three cases of ischio-rectal abscess. The incidence of the two diseases combined was thus just over 1 per cent.

Leslie collected significant data and found that "the incidence of abscess and fistula in tuberculous individuals is 2.3 per cent." He found also that in two large general hospitals there were fifty-five cases of fistula in a total registration of 9,029, an incidence of 0.60 per cent. He believes that "fistula-in-ano is associated with pulmonary tuberculosis in such a relatively high percentage of cases as compared with any other group as to indicate causal relationship." In this opinion I agree with him.

In the group of 721 cases occurring in the Mayo Clinic from 1922 to 1926, inclusive, there was evidence which pointed to associated tuberculosis in eighty-three (11.5 per cent). This evidence was furnished by roentgenograms of the chest, physical examination and tissue examination. Of 119 pathologic examinations of fistulous tissue, tuberculosis was reported in ten.

In any study it is only possible to show evidence indicating the connection between the fistula or abscess and tuberculosis

as a cause. This is due to the fact that one cannot even in a fair percentage of cases accurately determine the presence of tuberculosis by examination of the fistula itself. One authority will maintain that guinea pig inoculation is the most valuable method of diagnosis and adds that it is positive in 20 per cent of all cases. Others have favored microscopic examination of the tissues or smears taken from the discharges. But none of these methods is infallible and the result is that all laboratory methods as well as clinical investigation must be relied on to determine the nature of the lesion.

From the standpoint of fistula in ano however the anal crypts are the important consideration and it is within these little pockets that the infection begins which ultimately results in the formation of the fistula. It has usually been said that fistulas about the anus originate as abscesses but this is scarcely true. The abscess is an important stage in the development of the fistula but the origin of the abscess as well as the fistula is the infection that begins in the anal crypt.

#### PATHOLOGY

Infection may be provoked by any condition which traumatizes the crypt such as foreign bodies overstretching due to constipated stools and diarrhea (Fig 758a). This may be called cryptitis since with this infection an inflammatory reaction is set up in the crypt and the tissues surrounding it. Edema ultimately closes the crypt opening as the papilla becomes enlarged and often adherent and a pus pocket develops whence the burrowing process begins and extends in various directions. The fistulas most commonly pass between the external and the internal sphincters of the anus. Next in frequency is the tract which passes externally to both muscles and third the type which goes through the body of the external sphincter.

I do not make a definite classification because there is no advantage to be gained by it and there are some disadvantages the supposed incomplete external fistula is an impossibility. Such a condition implies the absence of an internal opening and

the very nature of the disease precludes such a possibility. There are many times when the surgeon, being unable to locate the internal opening, states that there is none, but this is erroneous; all anal fistulas have internal openings.

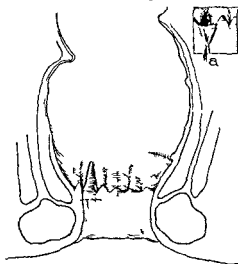


Fig 758 —Infection beginning in crypt

Occasionally a tract will burrow from its source under the pectinate line between the anal muscles and up under the rectal wall forming an abscess which adheres to it and ultimately rup-

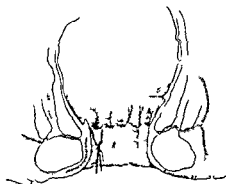


Fig 759 —Abscesses note muscle spasm after tracts burrow through blocking the escape of pus through anal crypt and consequent abscess external to muscles

tur through into the rectum. In addition to this the tract may extend externally under the buttock and rupture through the skin as illustrated on the right side (Fig 759). It is in such

a case that one is easily misled because when the probe is inserted into the external sinus (or when methylene blue barium or other solutions are injected) the point of the probe or the solution will come through above the anus. Unless the true origin of the infection is appreciated one will make the error of regarding this high sinus as the starting point of the fistula. It is well to know of this high sinus provided it is clear that it is merely a subsidiary of the main tract coming from the anal canal even as the limb is which extends to the external sinus.

Suffice it to say that the infection beginning in the crypt forms a sinus which passes most frequently between the anal sphincters and it is this fact which accounts for the formation of the abscess. As the tract involves the fibers of the anal sphincters a spasm is set up which cuts off the return flow of the pus; the resultant accumulation in the ischiorectal fossa is the abscess which causes the patient to summon aid. Occasionally enough of the muscle is destroyed as the sinus bores through to do away with the spasm and the pus is able to get out through the anal canal at the portal of entry of the infection. In such a case there is often no rupture externally and consequently the fistula is not completed. The result is a blind sinus the so called blind internal fistula.

### OPERATION

**Preparation of Patient** No supper is allowed on the evening previous to the operation and rectal injection consisting of mineral oil 3 ounces and a pint of warm water is given to be retained all night. About an hour previous to operation another rectal injection of mineral oil 3 ounces and a quart of warm water is given and expelled as indicated by the desire of the patient. The lower part of the rectum and the anus are then irrigated and the anal margins are shaved and prepared with 3 per cent mercurochrome.

**Anesthesia**—Sacral and caudal anesthesia are to be preferred to any other type. In fact, this applies not only to operations on anal fistulas but to all forms of anal and rectal surgery. What is most desired of any anesthetic in this region

is relaxation of the anal sphincters without distortion and certainly this type of anesthesia accomplishes complete incompetence of these structures. It is well known with ether anesthesia the anal sphincters are among the last of the muscles of the body to relax, because of this the patient has to be saturated to the point of toxicity before proper exposure can be obtained. The deformity associated with local infiltration makes it unsatisfactory. I believe that regional anesthesia has its nearest approach to perfection in rectal surgery.

**Position of patient**—After anesthesia has been completed the patient is allowed to remain in the prone position. When the pelvis has been elevated on a transverse bar attached to the table (kidney rest), the position is satisfactory for the operation. The rectum can be explored to the rectosigmoid and even above, through an anoscope and antiseptic solutions can be applied to the wall of the bowel and the anus. Excessive dilatation and divulsion are unnecessary and except when there is organic contraction or excessive spasm it is only necessary to dilate the anus to a diameter of about 5 cm. With sacral or caudal anesthesia or both if necessary the anus is incompetent and remains open after the withdrawal of the dilating fingers. By simply retracting the buttocks forcibly the pectinate line can be seen and the crypts explored without difficulty. One cannot avoid contrasting the ease of such an operation with that performed with the patient in the lithotomy position under general anesthesia. In the first instance the patient is awake and in a comfortable position and can cooperate by breathing quietly, avoiding straining or coughing and resting easily on the table. The assistants are in a satisfactory position and can make use of both hands comfortably while helping the surgeon. The instrument tray can be placed conveniently. There is no bulging and protrusion of the anal margins and consequent excessive bleeding and distortion. In the case of ether anesthesia and the lithotomy position the patient is unconscious and straining, vomiting and struggling most of the time (especially while the sphincters are being dilated). The assistants must 'hug' the extremities of the patient which project upward and interfere

with every move that is made to help, the surgeon sits on his stool with a pan at his feet to receive the excessive amount of blood which is uselessly lost, due to the delay in securing the bleeding points and the impossibility of controlling them entirely because of the increased pressure within the varicose veins about the anus and lower part of the rectum

**Abscess**—The first evidence of an anal fistula noted by the patient is usually swelling and pain during the abscess stage. There may be some soreness and irritation during and after defecation, previous to the actual development of the abscess, but it is not usually sufficient to cause the patient to consult a physician. Delay is further caused by the reluctance of patients to present themselves for examination for any kind of rectal disorders. Consequently when first seen by the physician, there is usually a full blown abscess with excessive pain and a general reaction with fever.

It is generally conceded that the proper procedure in such cases is prompt and radical incision and drainage. The application of hot wet compresses immediately and constantly until the inflammatory reaction about the abscess and in the adjacent tissues subsides is a valuable aid in lessening the length of convalescence. The method of incision is usually such that, as Fansler expresses it, the abscess is scalped. This is brought about by first incising crucially and then cutting away the "points" in such a way as to obviate any possibility of obstruction to the escape of pus. Curetting must not be done under any circumstance, it is desirable to leave the pyogenic wall intact. However it is necessary to be sure that there are no pockets of pus so hidden away that they cannot be evacuated, the abscess should be explored very gently, and for this purpose the index finger is preferable to an instrument. In the case of tuberculosis, it is usually the practice, to make the crucial incision with a cautery knife and also to "cook" the walls of the abscess with an actual cautery. Packing tightly should be avoided. Iodoform gauze is generally used.

Before opening the abscess it is well to explain to the patient that it is only a palliative procedure and that a second operation

will be necessary later. In this manner much dissatisfaction is avoided.

**Fistula.**—Instead of injecting the external sinus or sinuses with methylene blue or other dye in solution, one makes a careful examination of the anal crypts. If a sinus is found, if a granular projection or an ulcerated area is noted, or if a crypt appears deeper than usual, a hooked probe is inserted and almost invariably enters what proves to be the internal opening of the fistula. After this is determined, the sinus or sinuses are opened externally. As they are opened they can be traced by the grayish-white color of the wall of the fistula which is just as

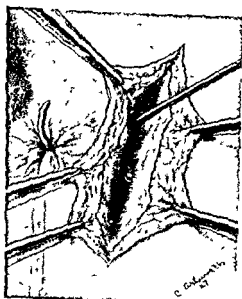


Fig 760 —Probe inserted into branch from anus

easily distinguishable from the normal tissue as those tracts which have been previously stained with dye. Moreover, there is the decided advantage of not having the blue stain or the yellow of bismuth mixtures smeared over the normal structures. After the tract or tracts have been traced toward the anus, a probe can be inserted into the involved anal crypt and passed easily into the opened tract at its nearest point to the anus. The injection of such solutions as methylene blue or bismuth in suspension into the external sinuses I have found unnecessary



and rather confusing. As the fistulas are opened these solutions are no longer confined to the tracts but cover the entire operative field, the gloves and the linen, there is also a squirt of the solution (land where it will) as the surgeon gives the plunger of the syringe a final push to exclude air before injection.

These injections are made ostensibly to discover the internal openings and afford one of the chief reasons why surgeons are unable to find them. With the proper understanding of the usual site of these openings and the ease of locating them, I have found this supposed aid unnecessary. The scarred walls of the tracts free from stains are much more easily traced as

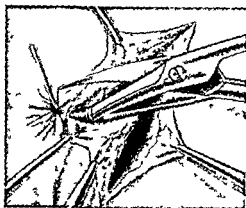


Fig 761 —Cutting the external sphincter

they are opened. Often the opening of a branch of the fistula will present itself clearly in the wall of one of the sinuses already opened and will admit a probe which will readily appear in the anal canal (Fig 760). After this connection has been established it is only necessary to lay the tract open by incision, thus converting the entire fistulous "tunnel" into an uncovered "ditch" (Fig 761).

There is a fairly constant rule which can be observed in tracing the tracts of the fistula from the external sinus. If this opening is anterior to a line drawn through the anus and between the ischial tuberosities, it will usually be found to be connected with the anal canal by a tract which runs in a direct line

to a crypt in the anterior half of the anus. If, however, the external sinus is posterior to such a line, the tract will usually be found to curve around and enter the anus in the posterior quadrant.

I am often asked whether I cut both sphincters when operating on a fistula-in-ano. From the nature of the origin of the disease, and its position, it is obvious that such a procedure is rarely necessary, and that usually, section of the external sphincter alone is sufficient.

Often surgeons are sorely taxed in their attempt to locate the internal opening of a fistula. Their inability to locate it or to

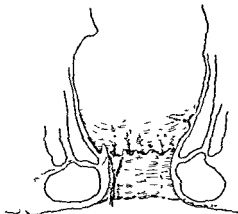


Fig. 762.—Rupture of abscess relieves pressure and often results in healing of crypt and inner extremity of sinus, explaining so-called "incomplete external" fistula.

get probes or colored solutions through can be explained in some instances by muscle spasm and in others by the tendency of the internal opening to heal after the abscess has ruptured and the pressure has been relieved from the outside (Fig. 762). I have often opened the fistulous tracts throughout their numerous ramifications without having been able to identify either a branch from the anus or an open crypt within the anus through which I might discover a sinus leading to the branches of the fistula already opened. In such cases I have often found a scarred and healed crypt through which a probe could be passed into the fistulous tracts. I have done this so consistently with the ulcerated crypt which is open or presents granulation tissue

or other evidence of disease that I am now inclined to explore the fistula from within the anus outward toward its branches instead of the reverse as has been the usual custom

A roentgenogram after injection of the fistula with bismuth or barium in suspension 40 per cent iodized oil, or other opaque solutions, will often help to determine the extent of fistulas that extend into the pelvis. With the aid of stereoscopic plates, the direction of such tracts can be determined with fair accuracy

After the fistula has been cut through to its internal opening the remainder of the operation is devoted to cleaning up the margins of the wound and doing as much as possible to facilitate the dressing and other measures concerned with the post

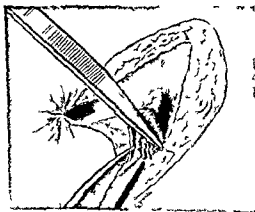


Fig. 763 — Excising portions of fistulous tracts

operative management of the wound. This is, I believe, far more important than anything else concerned with the cure of the fistula, except the discovery of the internal opening and uncovering the fistula to it

The wound margins are trimmed away. Whether the tracts should be excised must be determined in general by the type of the tracts and the direction of their ramifications. The more superficial and distal branches of the complicated fistulas may be excised (Fig. 763), but when they pass deeply into the pelvis or the structures of the buttocks, involving a great sacrifice of tissue, I believe excision should be avoided. Often excision and

suture of the distal limbs of a fistula will induce early closure and save much time and trouble (Fig. 764).

Sometimes in extensive fistulas it is well to open all the branches to the anal margin at the time of the operation, without cutting through the anal canal to the internal opening. In this manner the complicated fistula with multiple tracts is converted into a simple, direct fistulous tract with one external opening. A silk thread may be passed through this fistulous remnant temporarily and tied. Later, when the branches have begun to heal, the remaining sinus can be cut through with little difficulty. The advantage of this method lies in the fact

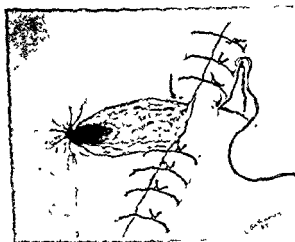


Fig 764 —Suture of distal limbs of wound

that in extensive cases there is so much cutting necessary that it is difficult to control the slough and it is better to delay cutting through the anus until the sloughing process has been controlled and the wound at the anal margin can be kept in a healthy state.

When a branch goes up under the rectal wall it is only necessary to clean it out and irrigate and put in a drain at each dressing. The fact that the incision has been carried through to the internal opening and all the tracts uncovered converts this branch into an external sinus, and deprives it of the supply of infected material which has been keeping it "alive." Therefore, its source of infection is cut off and it will henceforth drain externally. It can be kept clean and will heal.

The part of the tract which passes between the muscles need not be excised although the muscle must be cut through. Occasionally in a simple direct fistula which has become chronic and fibrous the entire tract may be excised and even closed by suture. Some of them will heal by primary union but this is a rare possibility and in general it is best to avoid suture of the tracts near or through the anus. When they have been converted into an open wound the accumulation of the infecting agent can be avoided by careful postoperative management. By allowing the wall of the tract to remain good fibrous tissue is provided about which further formative changes will develop which will cause the severed muscle ends to adhere to the scar instead of retracting. In this manner the muscles pull on each side of a body of scar tissue and the result is the same as if the muscle fibers were continuous.

The treatment of an anal sinus or the so called blind or incomplete internal anal fistula is essentially the same as in the case of those which are complete. There is of course no external opening so the tract must always be uncovered from within the anal canal and outward. A probe is inserted into the diseased crypt by means of an anoscope or a bivalve speculum for retraction and the incision begun at this point. Thence the branches are opened the external sphincter being severed (when the tract goes between the anal muscles) and the incisions carried out to the extremities of all the ramifications.

In those rare instances in which there is an opening into the rectum above the pectinate line (complete internal fistula) it must be remembered that there are two internal openings. The incision is carried through the external sphincter to the anal opening following which there is a choice of two procedures. Sometimes the sinus and the rectal wall are opened by incision between the crypt and the high opening in other instances when there has been great destruction of tissue it is better to pass a thread of heavy silk through the tract and out of the sinus in the rectal wall. Then if the ends of the thread are brought together and tied in a slip knot the ligature can be tightened at intervals until the tract is cut through. In this manner the tract usually heals behind the constricting thread.

as it cuts the bowel wall and healing is obtained without loss of tissue and retraction, which accompanies the knife incision.

Often, when the high sinus results from the improper use of a probe, it can be disregarded and treated as the blind limb of other branching "complete" internal fistulas with an arm projecting under the bowel wall. The perforation due to the probe-point is not often sufficient to produce a permanent sinus, probably because there is not much trauma and the opening is small; and it will usually heal without trouble. In such cases, however, one should be careful to avoid forcing gauze drains to the upper limit of the tract, because if the gauze should be forced through, it would produce a sinus which would have to be treated as a fistula.

The operation for internal fistula is essentially the same as that for "blind internal fistula," except that it is necessary to trace the sinus up under the bowel wall instead of outward into the ischiorectal fossa.

#### DRESSINGS

After the operation has been completed a piece of iodoform gauze, wrapped in rubber tissue, is inserted into the anal canal (Fig. 765), and further dressings of iodoform-gauze are inserted into the wound. Forceful packing should be carefully avoided. When the wounds are superficial, it is only necessary to put in sufficient gauze to fill the wound and keep the margins separated. When tracts extend into the pelvis or under the bowel wall, it is necessary to insert just enough gauze to insure drainage and only slight pressure should be used in applying the drain to the upper limit of the tract.

Some authorities prefer that the gauze-packs remain in situ for a period of three days, others require as long as twelve. Long delays in changing the dressing should be avoided. Certainly there is an advantage in keeping any wound clean, and when the discharges are as excessive, as they are in the case of fistulas about the anus, frequent dressings begun early are the greatest help in securing prompt healing. Of course it would be unwise to remove the gauze from a wound so early that it would leave a bleeding surface, but as soon as sufficient time has elapsed to permit withdrawal of the dressing without force and

without resultant bleeding the dressing should be changed frequently. In this connection I believe that most incontinence following fistulectomy is not due to destruction of muscle continuity by the knife but to destructive slough which occurs in unattended wounds following the operation. During the sloughing process which goes on in the dirty wound laden with its own purulent discharge much healthy tissue is destroyed and the divided muscle-ends have nothing to adhere to. Retraction of the muscle is followed by incontinence. When the wound is

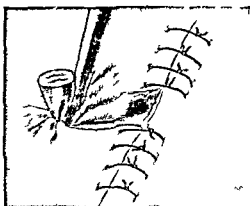


Fig. 765.—Cigarette drain through anus. Iodoform gauze in wound.

kept clean by daily attention further loss of tissue is avoided. The margins are clean and healthy granulations develop finally into good fibrous bands adherent to the cut ends of the sphincter. There is no retraction of the muscle ends and incontinence is seldom seen. The postoperative care of the wounds is of equal importance with the operation and liberal use should be made of all methods contributing to cleanliness.

If gauze adheres to the wound it should not be drawn forcibly away leaving a bleeding surface. Sufficient time should be allowed to permit the fibrous exudate to become organized on the wound surface. However as the gauze is trimmed away piecemeal antiseptic irrigations and hot wet dressings can be used to advantage. The rectum should be irrigated after each stool in order to lessen as much as possible the passage of infected discharges over the wound.

## OTHER TYPES OF TREATMENT

Except in cases complicated by advanced pulmonary tuberculosis the accepted treatment of anal fistula is surgical. Variations in the type of operation have been described. Some advise curetting the tracts, others advise excision, while still others prefer to leave them alone. Operations have also been described the object of which is to pull the mucosa over the internal opening in some way and attach it there. Such operation is impracticable and unproductive of satisfactory results and, in my opinion, is not based on a sound idea of the origin of the disease. It appeals to many because it relieves them of that supposedly fearful burden of cutting the sphincter and in this way it does harm, because the operation is more often unsuccessful, and a curative operation is usually necessary later.

Most authorities agree that "burning" operations are more applicable in tuberculous fistulas. I have not found use for it, and Bliss never uses the cautery, although he finds that anal fistulas are the "commonest surgical lesion" among his patients in Wu Chang. He reports also that 18.7 per cent of the fistulas in his cases were tuberculous.

So called medical treatment usually consists of some form of irrigation of the sinus tracts, or the injection of these sinuses with some inert medicated substance such as bismuth paste. The former is almost always unsuccessful, and the latter has been productive of varying results in the hands of different authorities most of whom are not satisfied to use it except in a rare case after numerous operations have been tried unsuccessfully. Bismuth injection does seem to close the sinuses in some instances, but the paste lies in the tissues as a foreign body and ultimately the trouble too often recurs as the discovery of this yellow paste in the tissues attests.

Heliotherapy, treatment with different types of light, and roentgen rays have all been tried and varying degrees of enthusiasm have been manifested by those who have made use of them. Such outbursts of enthusiasm are often temporary and ultimately their protagonists return to surgical eradication of the disease whenever it is possible and advisable to do so.



## SUMMARY

The anus is always the primary seat of fistula in ano which begins as an infection of a crypt of Morgagni. Tuberculous fistula is not as common as was formerly believed nor is fistula in ano by any means prevalent among tuberculous subjects.

Since the fistula progresses from the crypt incomplete external fistula is impossible there is always an internal opening although it may be difficult to find.

The sinus from the crypt usually passes between the anal sphincters. The spasm of these muscles bars the egress of pus and abscess results at the distal end.

For operation sacral and caudal anesthesia with the patient prone provide great advantages. Breathing is easy straining is absent the sphincters are flaccid and hemorrhage is less severe the field is easily exposed and the assistants are not interfered with as they are by the lithotomy position.

A full blown abscess is usually present when the patient is first seen. Immediate operation is advisable. After a crucial incision the points are cut away to establish free drainage but curetting is not to be done the cavity is explored with the finger only.

Injection of sinuses with dyes or pastes for diagnosis is unnecessary and undesirable. The affected crypt is first sought and a probe inserted. The usual method is to explore the sinuses from without inward but in most cases the reverse is more satisfactory. The sinuses can be readily traced by their grayish white color. It is rarely necessary to cut more than the external sphincter.

The treatment of the sinuses so as to facilitate drainage and dressing is far more important than any other step except discovery of the internal opening and the fistula from it. The margins of the wound are trimmed and certain fistulous tracts excised. Near the anus and especially between the sphincters, it is better to allow the scar to remain. The scar tissue affords a firm attachment between the severed ends of the external sphincter, so that function of this muscle is progressively restored with healing of the wound.

Dressings should be applied under gentle pressure; forceful packing is to be avoided. Dressings should not be left too long, nor should healing be delayed by forcible removal of adherent gauze. Antiseptic irrigations and hot wet dressings help to free the gauze and to keep the wound clean and draining freely.

There is considerable difference of opinion concerning the advisability of curetting, cauterizing, and excising tracts, and various methods have been advocated. Medical treatment, consisting of irrigation of the sinuses or injection of them with medicated substances, is of doubtful value and should be instituted only rarely. Treatment with different kinds of rays has not been generally successful.

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## EXTRA-UTERINE PREGNANCY: SUBSEQUENT PREGNANCIES

JAMES C MASSON AND HAROLD E SIMON

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THE incidence of recurrence of extra uterine pregnancy has been discussed by various authors. In most instances their conclusions have necessarily been drawn either from the review of a small series of cases or from a series of cases noted in the literature. Usually the incidence of recurrence has been considered to be identical with the percentage of recurrence in any given series of patients operated on for extra uterine pregnancy without regard to the subsequent history. Observations on the incidence and character of intra uterine pregnancy occurring subsequent to extra uterine pregnancy, have been limited, and are not readily available.

Without these facts it is difficult to decide what course should be adopted in regard to the sterilization of patients who are being operated on for extra uterine pregnancy. The present study has therefore been undertaken and the antecedent and subsequent histories of 198 patients operated on for extra uterine pregnancy have been reviewed over periods varying from six months to twenty four years.

### LITERATURE

Heineck, from a study of eighty nine cases reported in the literature and three personal cases concluded that recurrence in the opposite tube is exceptional, and that many cases of normal pregnancy occur subsequently. He therefore considered sterilization to be unjustified. Rongy, on the other hand, believed that repeated extra uterine pregnancy is more frequent than is generally supposed. He advocated the preservation of the remaining tube when the patient had not had children, but patients

with three or more children he believed should with their consent be sterilized

Wells in 1920 noted in the literature ninety nine cases of repeated extra uterine pregnancy and showed that they are not extremely rare. He concluded that although recurrence may be expected in a large proportion of subsequent pregnancies sterilization is not justifiable at the time of the first operation but the course of subsequent pregnancies should be closely watched

Rabinovitz reviewed the literature and accepted as authentic 147 cases of recurrence. He believed that if possible the other tube should be examined and invariably removed if there is a history or any tangible evidence of gonorrhea or previous pelvic inflammation

#### SUBSEQUENT PREGNANCIES IN THE MAYO CLINIC CASES

At the Mayo Clinic from 1903 to 1926 inclusive 445 operations were performed on 437 patients for extra uterine pregnancy. This number included seven cases of lithopedon in which the patients had passed the child bearing age at the time of their examination eighty one cases in which the operation performed was of such a nature as to preclude the possibility or probability of subsequent pregnancy fifteen cases in which the social status of the patient was such that the possibility of further conception taking place was slight and 136 cases in which for various reasons data concerning the subsequent history was not available. There remained 198 cases in which all the data for this study were available and in which it was theoretically possible for the patient to become pregnant. The period of observations in each individual case extended from the date of the first extra uterine pregnancy to the present to the onset of the menopause or to the performance of some subsequent operation which made pregnancy impossible (Table 1)

In the series of 198 patients eighty seven (44 per cent) had become pregnant subsequently while 111 (56 per cent) had not been pregnant when last heard from. In this series the proportion of patients with subsequent pregnancies will doubtless in

TABLE 1

THE INCIDENCE OF SUBSEQUENT PREGNANCY AT VARYING INTERVALS AFTER  
EXTRA UTERINE PREGNANCY

Interval years	Subsequent pregnancy cases	No subsequent pregnancy cases
1	0	1
2	6	14
3	9	12
4	6	12
5	9	6
6	6	5
7	3	6
8	5	5
9	7	8
10	8	2
11	4	8
12	3	4
13	5	5
14	4	3
15	1	2
16	2	5
17	4	3
18	0	1
19	2	4
20	0	2
21	2	0
22	1	1
23	0	1
24	0	1
Total	87	111

crease yearly because many of them are still in the child bearing age, and in fifty, or nearly half of those who have not again become pregnant an interval of only five years or less has elapsed since the operation for extra uterine pregnancy

In the eighty seven cases pregnancy had occurred 162 times an average of nearly two for each patient. One hundred and ten (68 per cent) of the 162 pregnancies were normal, thirty four (20 per cent) were intra uterine, but terminated as miscarriage, and only eighteen (less than 12 per cent) were extra uterine. Normal pregnancy alone occurred once in twenty nine instances twice in fourteen instances, three times in three instances and four times in three instances. Miscarriage alone occurred in three instances, and miscarriage and normal pregnancy combined occurred in eighteen instances.

The interval between the extra uterine pregnancy and the next subsequent pregnancy varied from less than one year to thirteen years (Table 2) but in 80 per cent the subsequent pregnancy had terminated less than four years after

TABLE 2  
INTERVAL BETWEEN THE EXTRA UTERINE PREGNANCY AND THE  
TERMINATION OF THE NEXT PREGNANCY

Years	Cases
1	24
2	24
3	13
4	8
5	2
6	4
7	1
8	3
12	1
13	1
Unknown	6
Total	87

The occurrence of normal pregnancy prior to the extra uterine pregnancy was apparently no indication of whether or not pregnancy would occur subsequently. In seventy nine of the cases in which subsequent pregnancy occurred it had occurred previously in fifty six (71 per cent) while in 111 of the cases in which subsequent pregnancy did not occur there had been pregnancy previously in more than 79 per cent.

#### RECURRENT EXTRA UTERINE PREGNANCY

In twelve instances extra uterine pregnancy occurred subsequent to operation in the Clinic and in six instances there was a history of extra uterine pregnancy occurring before the patient registered at the Clinic a total of eighteen recurrent cases (Table 3). It is somewhat difficult to estimate the percentage of recurrence from the data available because it is probable that a larger percentage of the patients who had recurrences returned than of those who had not subsequently become pregnant or who passed through an uneventful pregnancy. Furthermore this number (eighteen) included all the patients in the series.

437 who had had extra uterine pregnancies previously (six), but it includes only the subsequent extra uterine pregnancies (twelve) occurring in the 198 patients in whom the subsequent data were available. The true proportion of recurrences will lie therefore, between eighteen in 198 (9.1 per cent) and eighteen in 437 (4.1 per cent). There was no mortality in the series of recurrent cases.

TABLE 3  
RECURRENT EXTRA UTERINE PREGNANCY

Case	Previous pregnancies	Age at first extra uterine pregnancy years	Interval years	Inter uterine pregnancies
1	0	30	2	0
2	0	28	3	0
3	1 (Miscarriage)	38	0.5	0
4	?	19	13	?
5	1 (Normal)	25	4.5	2 (1 Normal 1 Miscarriage)
6	0	27	7	0
7	0	29	2	0
8	2 (Normal)	24	2	0
9	2 (Normal 1 Miscarriage)	34	2	0
10	4 (Normal)	34	3	0
11	1 (Normal)	23	4	0
12	1 (Normal)	27	2	0
13	1 (Normal)	32	2	1 (Normal)
14	0	29	4	0
15	4 (Normal)	29	1	0
16	1 (Normal)	21	5	0
17	2 (Normal)	34	8	0
18	0	30	9	1 (Miscarriage)

An analysis of the data in the cases in which there was recurrence fails to reveal any characteristics whereby the possibility of such a recurrence could be predicted. The average age at the time of the first extra uterine pregnancy was twenty eight and a half years, the youngest patient being nineteen, and the oldest thirty eight. Previous pregnancy had occurred in eleven of the eighteen cases and normal pregnancy or miscarriage occurred in the interval between the extra uterine pregnancies in three instances. The interval between the two extra uterine pregnancies varied from six months in one instance to thirteen years in another, but the average was four years.



In four instances the condition of the opposite tube was described at the time of the first operation. Twice it was described as normal once it was slightly enlarged and in one instance there were adhesions around it. Wells found that in twenty one cases of recurrent extra uterine pregnancy reported in the literature the condition of the other tube was noted at the time of the first operation. In thirteen cases it was apparently normal in six there were a few adhesions present in one there was some evidence of a salpingitis and in one the tube was poorly developed and tortuous. The observation of an apparently normal tube on the opposite side in fifteen out of twenty six of the cases in the two series is interesting but does not throw much light on the etiology of extra uterine pregnancy because the observations necessarily deal only with the external gross appearances of the tube and tell us nothing regarding the patency of its lumen the condition of the mucosa or the ability of the tube to function normally. Further these observations were made in our series on an average at least two years prior to the second pregnancy and during that time the tube may have undergone gross changes. The occurrence of extra uterine pregnancy in nearly 12 per cent of the subsequent pregnancies in these cases an incidence much greater than that in women in general indicates that the implantation of the fertilized ovum in the tubal mucosa is the result of some physiologic structural or pathologic abnormality rather than merely accidental. What the nature of these changes may be has not been proved conclusively and we shall not discuss here the various theories regarding the etiology of tubal pregnancy.

In one of our cases (Table 3 Case 3) in which the first extra uterine pregnancy occurred on the right side the right tube and the left ovary were removed at the time of the first operation. Less than six months later the patient again became pregnant and extra uterine pregnancy was diagnosed. At operation six months and nine days later an early tubal pregnancy was found on the left side. The ovum in this instance must therefore have migrated from the right ovary to the left tube as it is unlikely that it should have escaped from the left ovary and sur-

vived in the left tube since the time of the first operation six months before

### COMMENT

It is apparent from these statistics that in married women during the child bearing period the chances are good that pregnancy will occur subsequent to extra uterine pregnancy provided one tube some ovarian tissue and the uterus are in normal or fairly normal condition. Furthermore, a large proportion of these pregnancies terminate normally, and the incidence of extra uterine pregnancy is not high occurring in only between 4.1 and 9.1 per cent of patients. As far as we have been able to determine it is impossible to predict either from the patient's history or the condition of the other fallopian tube at the time of the first operation whether or not extra uterine pregnancy is likely to recur. The mortality rate from extra uterine pregnancy is low. The removal of both tubes, or other measures having for their purpose the sterilization of patients undergoing operation for extra uterine pregnancy, do not, therefore, appear to be justified. When the other tube or ovary is diseased, it should of course be removed if the patient's condition permits, but only when some condition is present which would in itself make future pregnancy dangerous, is sterilization justifiable.

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## THE REACTIONS OF THE SALIVARY GLANDS TO ROENTGEN RAYS

EUGENE T LEDDY

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THE sensitiveness of the salivary glands to irradiation has been known for many years. Bergonié and Spéder called attention to this exceptional susceptibility and cited many cases illustrating the rapidity of the reaction of the glands after irradiation. Ceresole wrote what remains the best clinical description of the early form of reaction and recorded twenty one cases. Many other authors have made more or less casual allusion to the behavior of the salivary glands after exposure to roentgen or radium rays. They mention the early and rapid swelling of the glands which so often follows irradiation of the lower part of the face and the upper part of the neck, but in most cases they only record the event without attempting to distinguish between the different phases of the reaction or factors that enter into it. So common are manifestations of the radiosensitiveness of the salivary glands that it is surprising that the subject should have received so little attention, and that so few experimental studies should have been undertaken to elucidate the mechanism involved.

The response of the salivary glands to roentgen irradiation manifests itself as an early, late, or combined reaction. The early or immediate reaction consists in acute swelling of the irradiated glands, beginning from three to six hours after exposure, increasing to a maximum in from five to eight hours, decreasing rapidly, and disappearing in from twelve to thirty-six hours. A sensation of tension and slight tenderness on pressure are the chief symptoms, but the movements of the jaw may be interfered with slightly. Unless warned of the possibility beforehand, the patient may think he has mumps or he may com-

plain that the treatment has caused an injury. The distribution of the swelling varies according to the glands that have been exposed to the direct action of the rays. Under ordinary therapeutic conditions, the acute swelling and other symptoms are never severe and subside spontaneously, without leaving any trace.

The late reaction appears from one to three weeks after strong doses of roentgen rays as a sensation of dryness in the mouth from depression of the secretory activity of the glands and at times as stiffness of the cheek from direct effect on the buccal mucosa, it lasts for from two to four weeks and is most intense if both sides of the face and neck have been irradiated heavily. When a single gland has been exposed, or when irradiation has been confined to one side of the face or neck the normal secretory activity of the remaining glands is generally sufficient to moisten the mucous surfaces adequately, at least the patient is not aware of any abnormality. Occasionally, as a late phenomenon, "bad taste" may be mentioned by some patients, but the cause of this is obscure. The late reaction also abates spontaneously but more slowly and some degree of dryness of the mouth may continue for several weeks, or indeed for several months.

The combined reaction is, as its name implies, a combination of the early and late forms of reaction. The immediate swelling of the salivary glands on one side or on both sides, with the sensation of tension and tenderness on pressure, does not subside as rapidly as usual, and is accompanied or followed by dryness of the mouth and the other symptoms of late reaction. This occurs only when all the salivary glands have been exposed to the rays especially after heavy doses. The combined reaction diminishes gradually, but dryness of the mouth may annoy or distress the patient to some extent for several weeks or even for a longer time.

The likelihood of acute swelling of the salivary glands following roentgen ray treatment of facial and cervical lesions, should be borne in mind to obviate alarm and concern on the part of the patient and the attending physician, who, otherwise, may

misinterpret as serious complications these manifestations of benign reaction which are expressions of the exceptional radiosensitiveness of these glands. Infectious parotitis phlegmon of the cheek and uncommon complications of roentgenotherapeutic procedures should not give rise to any difficulty in differential diagnosis if the sensitiveness of the salivary glands to roentgen rays is remembered. The transient course and harmlessness of the early reaction are its essential characteristics. No treatment is required as the acute phenomenon of the glands subsides spontaneously.

The data from a group of 100 unselected cases in which the cervical region was irradiated in connection with the treatment of various lesions are submitted to substantiate previous reports to determine the incidence of the reaction under therapeutic conditions and to ascertain the severity of the accompanying symptoms. Patients in whom one or more cervical fields were irradiated were regarded as prospects for the reaction. In this connection a brief description of the variations in the roentgenologic technic used may be in order.

1 High voltage technic usually consists of 200 kilovolts peak, 5 milliamperes, 50 cm. target-skin distance, 0.75 mm. copper, and 1.00 mm. aluminium filter, for seventy or eighty minutes. This is used in the treatment of carcinomatous metastasis to the cervical nodes and is directed generally to each side of the lower part of the face and neck to "cross fire" the region.

2 Moderate voltage technic usually implies 135 kilovolts peak, 5 milliamperes, 40 cm. target-skin distance, exposure varying from eighteen to twenty minutes with a 4 mm. aluminium filter, and from thirty to forty minutes with a 6 mm. aluminium filter. An aluminium filter, 4 mm. thick, is commonly used in the treatment of cervical adenopathy in lymphoblastoma, tuberculous adenitis and so forth. This technic with the rays directed downward and backward, also is often used in the prophylactic postoperative treatment of the supraclavicular space in cases of carcinoma of the breast. The same factors but with an aluminium filter 6 mm. thick are used in the treatment of the more bulky lymphoblastomatous nodes and sometimes also in irradiation of

the supraclavicular spaces In irradiation of the supraclavicular and other cervical lymph nodes it often happens that the field includes at least a portion of the parotid or submaxillary salivary glands

This study covers 100 unselected cases in which the neck was exposed to roentgen rays for various conditions In thirty eight of these early reaction of the salivary glands occurred The symptoms of the early reaction were as follows painless swelling in nine cases painful swelling in eight, feeling of tension in six trismus of the jaws in six, dryness of the mouth in two 'bad taste' in one case and combinations of these symptoms in six

The symptoms of the late reaction were as follows dryness of the mouth in four cases, stiffness of the cheeks in two and 'bad taste' in four The patients having reactions were treated for a variety of conditions including carcinoma of the breast (prophylactic), nine, lymphoblastoma, nineteen, carcinomatous metastasis to the cervical lymph nodes, seven and tuberculosis and so forth three

It is probable that greater care in including only those cases in which some portion of one or more of the salivary glands was exposed to the direct action of the rays would have yielded a still greater proportion of cases with reaction The dose of radiation absorbed by the salivary glands must be the essential factor in the reaction (Table 1)

The low incidence of reaction of the salivary glands in cases of carcinoma of the breast treated by irradiation is accounted for by the fact that the glands are seldom included in the field of irradiation When reaction does occur it is because a field included a portion of the glands usually part of the submaxillary The higher incidence of reaction in cases of lymphoblastoma is due to the fact that the lower part of the face and upper part of the neck are usually exposed to direct irradiation Early reaction occurs in all cases in which the salivary glands are exposed to the direct action of the rays

Irradiation at moderate voltage for twenty minutes with rays filtered through 4 mm of aluminium had less effect than irradiation for thirty five minutes with rays filtered through 6 mm of

TABLE 1  
INCIDENCE OF REACTIONS

	Cases	Per cent
Carcinoma of the breast treated	23	
Salivary gland reaction	9	30 1
Lymphoblastoma treated	37	
Salivary gland reaction	19	51
Cases treated with high-voltage roentgen rays	7	
Salivary gland reaction	7	100
Cases in which salivary glands were irradiated directly	23	
Salivary gland reaction	23	100

aluminium. This undoubtedly reflects the difference in the proportion of rays absorbed by the glands. Unfiltered rays, such as are generally used in dermatologic treatment, do not cause reaction of the salivary glands and will not be discussed here. High-voltage radiation to one side of the neck usually produced more effect than moderate voltage similarly applied. As might be expected, bilateral irradiation of the face and neck with high voltage was found to produce the maximal reaction in the salivary glands. The speed of the response which develops and the intensity and duration of both the early and late stages are roughly parallel to the effective dosage. An exception was noted in the blond patients, four of whom responded as markedly to moderate voltage and 6 mm. aluminium for thirty-five minutes (cross-fire) as did most of the brunettes to a high-voltage cross-fire for from seventy to eighty minutes. This fact indicates that personal susceptibility may sometimes be a more important factor than variation in roentgen-ray technic. It might be mentioned that age and sex played minor parts in determining the intensity or other characteristics of the reaction, for all the patients were adults, and of those with reaction eighteen were men and twenty women.

The same dose of roentgen rays repeated after all effects have



the supraclavicular spaces. In irradiation of the supraclavicular and other cervical lymph nodes it often happens that the field includes at least a portion of the parotid or submaxillary salivary glands.

This study covers 100 unselected cases in which the neck was exposed to roentgen rays for various conditions. In thirty eight of these early reaction of the salivary glands occurred. The symptoms of the early reaction were as follows: painless swelling in nine cases, painful swelling in eight, feeling of tension in six, trismus of the jaws in six, dryness of the mouth in two, "bad taste" in one case and combinations of these symptoms in six.

The symptoms of the late reaction were as follows: dryness of the mouth in four cases, stiffness of the cheeks in two, and "bad taste" in four. The patients having reactions were treated for a variety of conditions, including carcinoma of the breast (prophylactic), nine, lymphoblastoma, nineteen, carcinomatous metastasis to the cervical lymph nodes, seven, and tuberculosis and so forth, three.

It is probable that greater care in including only those cases in which some portion of one or more of the salivary glands was exposed to the direct action of the rays would have yielded a still greater proportion of cases with reaction. The dose of radiation absorbed by the salivary glands must be the essential factor in the reaction (Table 1).

The low incidence of reaction of the salivary glands in cases of carcinoma of the breast treated by irradiation, is accounted for by the fact that the glands are seldom included in the field of irradiation. When reaction does occur it is because a field included a portion of the glands, usually part of the submaxillary. The higher incidence of reaction in cases of lymphoblastoma is due to the fact that the lower part of the face and upper part of the neck are usually exposed to direct irradiation. Early reaction occurs in all cases in which the salivary glands are exposed to the direct action of the rays.

Irradiation at moderate voltage for twenty minutes, with rays filtered through 4 mm. of aluminium, had less effect than irradiation for thirty five minutes with rays filtered through 6 mm. of

The incidence (38 per cent) given in Table 2 may convey an erroneous impression of the frequency of the reactions in the salivary glands, for it represents only the total reactivity of the group under consideration (100 unselected cases). When, however, the glands were irradiated directly (twenty-three cases), all reacted. Therefore it is clear that irradiation of sufficient intensity will produce swelling and the other symptoms in all cases. In a few control cases in which a gland area was irradiated with half an erythema dose or less, the reaction was either mild or absent.

Because of the temporariness of the reactions, their slight clinical significance and importance in contrast to the severity of concomitant diseases under treatment, and the spontaneous regression of all symptoms without sequelæ, the mechanism of these reactions has been little investigated and is imperfectly understood. Whether they are due to inflammatory edema or hyperemia produced by roentgen rays, which blocks normal excretion and so produces swelling; to plugging of the ducts by other means, to effects in the glandular epithelium, or to injury to endothelial structures, are unsettled questions. Doubtless the late reactions are direct depressive effects.

### SUMMARY

Swelling and tenderness of the salivary glands are frequent with the technics described. The early and late reactions, varying in severity, subside spontaneously. Fairly direct irradiation with a fairly intensive dose is needed to evoke the reaction. The parotid gland reacts more readily than the others. The sensitivity of the salivary glands is much greater than that of normal skin. The effects of reactions do not need treatment. Reports of previous investigations on the subject are corroborated.

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## ANESTHETICS USED IN THE MAYO CLINIC IN 1926, ESPECIALLY OIL-ETHER COLONIC ANESTHESIA

JOHN S. LUNDY

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THE development of methods of anesthesia applicable to special branches of surgery will be reflected in the annual report of an active department of anesthesia. The gradual change in the use of various anesthetics in the Mayo Clinic has been noticeable.<sup>4</sup> In 1925 an increase in the use of combined anesthesia was predicted for 1926 and was borne out by the appended tabulation. Combined anesthesia has been widely recommended for a number of years, and its increasing popularity will no doubt continue, although its application is limited, as it is more useful for the weak than for the robust patient. Nevertheless if a routine method of anesthesia were compulsory, combined anesthesia would be worthy of a great deal of consideration.<sup>3</sup> Until a better method of the administration of ether than the open-drop method is developed, I would expect the use of combined anesthesia to approach but not to exceed the use of ether.

The usefulness and, in some instances, the undesirability of certain forms of anesthesia have often been strikingly demonstrated by ultra-enthusiastic exponents of those methods. I believe it is advantageous to all concerned for the anesthetist to equip himself so that he can produce anesthesia by any method desired by the surgeon. As time goes on, agents and methods become favored, according to the individuals who use them and the conditions surrounding their use<sup>1</sup>: for example, the skill of the anesthetist in the use of many agents and several methods for each agent, the patient's general condition, the usual demands of the average surgeon or the unusual demands of certain surgeons, the operating room and the character of the equipment for operation and for anesthesia.

There will probably be little or no increase in the use of local and regional methods of anesthesia in the immediate future<sup>5</sup> I do not infer that local anesthesia is losing in popularity, it has been given an extensive trial and, although it is unable to meet all the needs of every operation in many instances no other form of anesthesia has been quite so satisfactory Therefore, in a short time it has probably found the logical extent of its application for the present in the Mayo Clinic Local anesthesia is seldom combined with ether by the open drop method

Spinal anesthesia was not used in 1925 or 1926 It is not contraindicated by certain conditions notably hypertension and will find its proper place as time goes on The severest critic of spinal anesthesia has no fault to find and nothing but admiration for the absolute anesthesia it induces but even its staunchest supporters are uneasy when untoward reactions become marked Good judgment in the selection of cases often determines the safety with which it may be used and supportive measures must be taken unhesitatingly in the untoward reactions I believe that if intra abdominal anesthesia is necessary and general anesthesia is absolutely contraindicated, spinal anesthesia might be considered

Nitrous oxid and ethylene either with or without ether was used less in 1926 than in 1924 or 1925 The increased use of carbon dioxid in connection with machine given anesthetics, which has been made possible by proper equipment has made for easier administration and as a result, nitrous oxid and ethylene will probably be used as much as in 1924 and 1925 Should intratracheal anesthesia become popular in this country, it will increase the use of machine given anesthetics

Chloroform is seldom used and will probably be discontinued during 1927 It has few friends and many enemies, and only a new method of administration will restore it to general use Ethyl chlorid as a general anesthetic has been used very little more than chloroform I anticipate an increase in its popularity, especially as an induction to ether and in conjunction with oil ether colonic anesthesia

The use of olive oil and ether in the colon to produce general

anesthesia is becoming increasingly popular, especially for plastic surgery of the face and radical operations on the frontal and maxillary sinuses. It was used ten times as frequently in 1926 as in 1925, and I expect it will continue to gain in popularity as rapidly in 1927 as it did in 1926.

The use of oil-ether colonic anesthesia was begun on a small scale in 1925. In that year the technic used was that described by Gwathmey. It was first used for external radical operations on the frontal sinus, and since 1925 it has been used for this type of operation as a routine. Oil-ether in the rectum has been utilized in a number of obstetrical deliveries.<sup>6</sup> A few patients were anesthetized by this method for surgical treatment of ankylosis of the jaw, and since then there has been a rapid increase in its use for many types of plastic operation on the face and head: operations on the nose; radical treatment of cleft palate in adults and large children who have had one or two previous operations; removal of lesions of the jaw or of the tongue, especially when cautery or diathermy is used; reconstruction of the lip by a pedicle flap, and a variety of miscellaneous operations. I have used oil-ether anesthesia to control the terminal convulsions of tetanus for six hours. I have used it in one case in two attacks of bronchial asthma in which exhaustion was extreme, and no attacks occurred for several months. Although excellent results have been obtained by this method, it has been used as a routine in only a few operations.

In 1926 the Gwathmey technic was continued, but I found that it was advisable to dispense with the magnesium sulphate, as it occasionally produced abscess or slough at the site of injection if given subcutaneously. In 1925 a 30 French catheter was used as a rectal tube, and it was left in place throughout the operation. The catheter was continued by an ordinary rubber tube with a clamp attached below a funnel. It was possible at any time to add or withdraw the anesthetic mixture to regulate the depth of anesthesia. In 1926 the large rubber rectal tube, designed by Gwathmey, was substituted for the catheter. A curved metal connecting-tube was inserted in the rectal tube, a binder of adhesive about 45 cm. long saddled over



thetist will usually find an enema tube available in any part of the hospital, whereas special tubes are often inaccessible

In order to minimize lifting of patients, especially if they are obese, the patient gets on the cart or litter, and lies on the

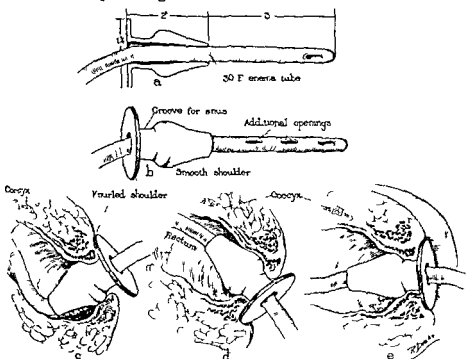


Fig 766—*a*, Cross section of metal button with a 30 French catheter threaded through it. The button is 5 cm long, and its greatest diameter is 4.5 cm. Seven and a half cm of catheter extend beyond the button. The lumen of the button is narrow at the point so that it makes slight pressure on a new catheter. Old catheters swollen from oil must be coaxed through the button with a crochet or other hook. The button slides easily on a tube if the tube is even slightly stretched by longitudinal traction. *b*, Complete button. The edge of the largest diameter is knurled, which makes the button less likely to slip. Additional openings may be cut in the catheter to facilitate drainage. *c*, First maneuver. The button is inserted and inclined toward the pubis to bring the posterior aspect of the anus into the groove on the button. *d*, Second maneuver. The button is inclined toward the coccyx in order to bring the anterior aspect of the anus into the groove on the button. *e*, The button lies on the longitudinal axis of the anus; the shoulder practically buried against and between buttock and anus.

right side while the tube is inserted. He is then turned on his back and his face is covered with three or four thicknesses of towel. If the patient to be anesthetized is not nervous, and the



operation is to be first on the list he may be placed on the operating table instead of on the cart and then anesthetized. The body binder on the operating table is thrown over the knees and the wrists are inserted in the wrist holders before anesthesia is begun. It makes little difference whether the patient is anesthetized on the cart or on the operating table if the knees and hands are secured. Struggling may thus be controlled if there is a stage of excitement. The retaining straps are unnecessary in about eight cases in every ten if ethyl chlorid inhalations are given intermittently during the first five or ten minutes of anesthesia or whenever there is evidence of too light a general anesthesia. Ethyl chlorid especially when reinforced with small amounts of ether by inhalation has shortened the usual slow induction so that if a generous quantity of solution is instilled into the rectum anesthesia may be complete in ten minutes after the instillation of the mixture. Some of the solution is withdrawn from the rectum as soon as anesthesia is established when a quick induction has been attempted.

The mixture of ether and olive oil is based on a percentage of 100 and the maximal concentration of solution used has been as follows:

For adults (1) 75 per cent ether and the balance olive oil in cases in which operation is performed in the open mouth (2) 70 per cent ether and the balance olive oil when the mouth is closed and can be covered with a square of gauze or sterile towel.

For children from two to five years of age 55 or 60 per cent ether with the balance olive oil.

For obstetrical cases 40 per cent ether and the balance olive oil.<sup>6</sup>

Gwathmey recommends 1 ounce of 65 per cent mixture of ether in olive oil for adults for every 20 pounds of body weight after  $\frac{1}{8}$  to  $\frac{1}{4}$  grain of morphin from 5 to 30 grains of chloretone and  $\frac{1}{200}$  to  $\frac{1}{100}$  of a grain of atropin have been given as preliminary medication. I give the average patient  $\frac{1}{8}$  grain of morphin and 1 150 grain of atropin forty five minutes before the anesthesia is begun. A 10 grain chloretone suppository is

inserted into the rectum fifteen or twenty minutes before it is planned to begin anesthesia. If the dose of morphin is smaller I use about 10 ounces of a mixture of 75 per cent ether and 25 per cent olive oil, and induce analgesia with ethyl chlorid. About 3 ounces of the mixture are withdrawn when anesthesia is satisfactory, or, when respirations become too shallow, fifteen or twenty minutes after the instillation has been completed. My idea is to use from 1 to 3 ounces more than the amount determined by body-weight, or from 1.5 to 2 ounces for each 20 pounds of body weight.

Morphin is as strongly indicated in oil-ether colonic anesthesia as it is contraindicated when ether is given by the open-drop method. The probable explanation is that, in inhalation anesthesia, morphin diminishes the volume of respiration so as to interfere with absorption of ether in quantities sufficient to produce relaxation. Morphin with drop ether, might depress respiration to such an extent that aeration would be insufficient for proper oxygenation. In colonic anesthesia, obviously the rate of absorption is not influenced by morphin, but the rate of elimination is in inverse proportion to the decreased volume of respiration caused by morphin. In a small series of cases in which no morphin was used, and elimination from the lungs was rapid, the instillation of as much as 23 ounces of 75 per cent mixture was required to maintain anesthesia, and it was also necessary to give ethyl chlorid frequently by inhalation. In order to make certain that means were available for de-etherizing patients, several have been given carbon dioxid and oxygen from a gas machine and de-etherized so that they were able to answer questions intelligently forty-five minutes after the administration of carbon dioxid and oxygen was begun. It is reasonably certain that a patient may be carried from deep colonic anesthesia to a zone of consciousness in a short time with the aid of carbon dioxid and oxygen. An attempt has been made to administer drugs, supposedly capable of stimulating the respiratory center, near the termination of anesthesia. If the respiratory center could be merely stimulated and the ether eliminated, the anesthetic effect of morphine would be desirable, and only its

depressant effect on the respiratory center would need to be overcome. More study of this point will be attempted.

For some time cathartics were administered the night before operation but after oil ether colonic anesthesia had been used on several patients who were entirely unprepared either by cathartics or enemas the undesirability of cathartics was recognized and they are no longer given. Patients are thus assured of rest undisturbed by cramps from cathartics the night before operation. Two or three enemas are given one or two hours before operation and are usually sufficient to empty the rectum enough for purposes of anesthesia.

In 1925 and 1926 almost every patient was examined in the Section on Proctology once before the colonic anesthesia was given and at two or three day intervals for a week or ten days afterward. Practically nothing of importance was found. Although there are some important theoretic reasons for proctologic examination before and after oil ether colonic anesthesia in patients of cancer age nevertheless digital examination of the rectum or none at all is enough in the majority of cases unless there is a history of rectal bleeding, pain, frequency or urgency or other suspicious symptoms.

For a time heavy liquid petrolatum or mineral oil was substituted for the olive oil in the oil ether mixture. It was satisfactory in all respects during anesthesia but the patient complained of cramps for several days afterward. Olive oil is now used as a routine because it is more satisfactory. Some patients have been given this type of anesthesia two or three times in a period of a week or ten days without any untoward effect. In some cases there is probably as much nausea and vomiting after this type of anesthesia if morphin is used as there is if ether is used by the open drop method. So far there has been no apparent untoward effect on those organs of the body such as the kidneys or lungs which occasionally are affected by anesthetics. We have not hesitated to use oil olive ether colonic anesthesia in cases in which there was a solitary kidney apparently in good condition and we have used it frequently when cauterization and diathermy of the various parts of the

mouth and tongue were to be done without packing of the pharynx

Oil ether colonic anesthesia has many possibilities and is of special value in plastic surgery and of considerable interest to all surgeons

#### TABULATION

#### ANESTHETICS USED IN THE MAYO CLINIC IN 1924, 1925, AND 1926

Anesthetic	1926 Per cent	1925 Per cent	1924 Per cent.
Ether	19.1	20.3	25.8
Local	42.7	45.0	43.2
Local and ether	0.8	1.7	1.4
Local and gases*	11.4	4.1	0.9
Gases*	25.3	28.4	27.6
Chloroform	0.1	0.09	0.03
Ethyl chlorid	0.1	0.1	0.2
Oil ether colonic	0.1	0.01	
Spinal			0.01

\* With or without ether

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